

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Insects Attacking Fruit Trees

LAWSON CAESAR.

INTRODUCTORY SECTION.

In the following pages we have not attempted to discuss or even refer to all the insects that attack fruit trees in Ontario, but have limited ourselves to those that are commonly found and that, except in perhaps one or two years out of twenty, do almost all the damage. These we have discussed somewhat fully in order that we might meet the needs, not only of the fruit-growers themselves, but also of public and high school teachers and district representatives.

A Spray Calendar for orchard trees has been included and should be consulted by every fruit-grower, as it applies not only to insects, but also to diseases.

CHANGES OR TRANSFORMATIONS UNDERGONE BY INSECTS.

Many insects, such as moths, beetles, flies and bees pass through four main stages in their life history, namely, adult, egg, larva (plural larvæ) and pupa (plural pupæ). The adults are usually, though not always, winged. The female adults lay the eggs. These hatch into what are called the larvæ. Larvæ of moths are often called caterpillars, those of beetles grubs, and those of flies maggots. The larvæ cast their skin from time to time to allow of growth. When full grown they change into what are known as pupæ. These usually are either brown or white, and do not eat but remain stationary until they are ready to transform into adults. Many, but not all, larvæ before pupating spin about themselves a protecting case of silk, often mixed with hair. This is called a cocoon. Insects with the above four stages are said to have complete metamorphosis.

Another great class of insects, such as grasshoppers, tree-hoppers, leaf-hoppers and plant bugs, have only three main stages, namely, adult, egg and larva. As a rule the larvæ of these insects are called nymphs. There is no pupal stage. The nymphs usually resemble closely the adults but never have fully developed wings, though the older ones have wing pads, which in the adults have developed into wings. Nymphs, like ordinary larvæ, moult from time to time, and at the last moulting become adults. Such insects are said to have incomplete metamorphosis.

A considerable number of insects, as for example the San José Scale, never lay eggs, but give birth to living young, while some other insects, such as Aphids, give birth to living young throughout the most of the season, but in late fall lay eggs. Quite a number of female insects are capable of producing young without mating with a male. This is known as parthenogenesis, or virgin birth.

One great division of insects has biting mouth parts and feeds by biting off little particles of the leaf or fruit, bark or wood, and chewing these. We call such insects *biting insects*. Caterpillars and beetles are examples.

HOW INSECTS FEED.

A second large division has not got biting mouth parts, but instead has four bristles fitting together and forming a sucking tube, enclosed in a soft protecting beak, or lip. With these bristles, which are sharper than a needle, they pierce the skin or epidermis of the part of the plant fed on and suck up the juice from within. We call these *sucking insects*. Leaf-hoppers, aphids and scale insects are examples.

A third class of insects have a sucking tube with a broad expanded lip at the tip. With this lip they lap up liquids, and, as it is furnished with a rasping device, also rasp solids and absorb small particles of them. Such insects may be called *lapping or rasping insects*. Examples are the House-fly, the Apple Maggot and the two Cherry Fruit-flies.

GENERAL PRINCIPLES FOR THE CONTROL OF INSECTS.

What has been said about the different kinds of mouth parts of insects is very important when we come to consider their control. It is clear that insects that bite out little particles of plant tissue and swallow them give us an opportunity to kill them by placing poison on the part of the plant attacked. *Hence for biting insects we spray the plant with arsenate of lead*, this being at the present time our most satisfactory poison because it sticks well to the plant and does not injure the foliage or fruit. Arsenate of lead is known as a *stomach poison* because it is taken into the stomach of the insect.

Sucking insects do not remove the tissues, but only extract the juice from beneath the skin or epidermis; hence *spraying for them with a stomach poison would be useless*. They must be killed by some substance that comes in contact with their body, such as strong lime-sulphur for scale insects, or tobacco extract or soap solutions or kerosene emulsion for aphids. We usually call such insecticides *contact poisons* because they kill by contact.

Rasping or lapping insects since they move around over the surface of the plant absorbing both liquids and solids may be killed by spraying with arsenate of lead.

There are other ways besides spraying by which we may help to control some of our worst orchard pests. One is by removing all sorts of rubbish in and around the orchard. The reason for this is that some insects winter under the protection of this rubbish and would perish if it were removed. Another helpful means is good cultivation. This aids by destroying pupæ that are in the soil and also by destroying weeds and grass on which some insects, as for example the Buffalo Tree-hopper nymphs, feed. A third way is to burn all prunings and brush early in the spring each year and thus destroy the insects within, such as Fruit-tree Bark-beetles or Shot-hole Borers, before they can emerge.

NATURAL FORCES THAT HELP TO CONTROL INSECTS.

Man is greatly assisted by nature in the control of insect pests; in fact the control of insects by natural forces is wonderful and affords a most interesting field of study. The following are some of the ways in which this is accomplished: Climate checks the progress of some insects, for instance the San José Scale seems unable to make any headway in the colder fruit-growing portions of the Province, and the Codling Moth, owing to a smaller percentage of a second brood in such districts, is also much less abundant. Late spring frosts sometimes kill great numbers of delicate recently hatched larvæ; alternate freezing and thawing

destroy some insects; heavy downpours of rain wash many small insects from trees and many of these never get back; a very cold, wet spring, as in 1916, destroys countless insects in their early stages; a cold backward spring may almost annihilate the Pear Paylla; and very hot spells in spring or summer often cause the disappearance of innumerable aphids.

Diseases of various kinds are very important factors in holding some of our worst insects in control. Wet seasons usually favour disease.

Predaceous insects such as Ladybird Beetles and their larvæ, Syrphus Fly and Lace-wing larvæ, Assassin Bugs and many kind of beetles prey upon insects and aid greatly in control, especially of aphids.

Parasitic insects such as Tachina Flies and Ichneumons lay their eggs upon or in caterpillars or other pests and the larvæ from these feed upon and destroy their victims.

Birds and several other vertebrates do their share to help and are sometimes of great assistance.

SPRAY OUTFITS.

Those who purpose buying a spray outfit and spray materials can find the addresses of the various manufacturers by looking over the advertisements in the *Canadian Horticulturist* and the various agricultural journals.

If there are only a few trees to spray, such as one finds in a back yard in a town or village, a small hand-pump, holding about five gallons of liquid, will suffice. This should be equipped with about twenty-five feet of good hose, a leakless stop-cock, an eight-foot rod and a good disc angle-nozzle. Some companies manufacture a special rod and nozzle, so that by adjusting the latter the spray may be shot to the top of even a very high tree. A machine of this character with all the necessary accessories costs about \$20.

For more than about a dozen large trees this small outfit is much too slow. If the orchard consists of not more than about six acres of large apple trees or of about ten acres of trees the size of a moderately large plum, cherry or pear tree, a barrel-sprayer will suffice. This, fully equipped, will cost from \$20 to \$40.

A double action or duplex type of pump gives considerably more power than a single action or barrel pump, and so will enable a person to cover more trees each day, especially if the pump is installed in a 120 or 160-gallon tank. This type of outfit without tank will cost from \$40 to \$60.

For all apple orchards larger than those mentioned above, a gasoline outfit is almost essential for good work. A power outfit of this type along with tank and trucks costs between \$200 and \$350.

Good care with any of these outfits will more than double their period of usefulness. Any kind of machine should be washed out each evening after spraying, and when the season's work is over should be well cleaned, oiled and put away in a dry place.

SOME SUGGESTIONS ON SPRAYING.

All trees should of course be pruned before they are sprayed and large apple trees should be headed back to a reasonable height, care being taken in doing so to give them a symmetrical, umbrella shape. If San José Scale is present, the rough, loose bark should be removed from apple trees.

Good spraying continued year after year should almost always result in from ninety per cent. to ninety-nine per cent. of absolutely clean, sound fruit. Unfortunately, not many of our fruit growers are good sprayers. The following are some

of the chief reasons for this: First, their outfits are not kept in good condition to do rapid, thorough work; often the pump needs repacking or the hose is too short, or the nozzle are worn out or are the wrong kind. Second, they do not study the nature of the disease or insect they have to combat, and so do not recognize the importance of promptly spraying at the special times indicated in the spray calendar. A spray applied a few days too early or too late will often mean complete failure. Moreover, the omission of one or more of the regular applications will often mean cull fruit. Third, in many cases not nearly sufficient material per tree is used, frequently only about one-third of the proper amount. It is absurd to expect the spray to keep all of an apple free from scab if only half of its surface is covered by the mixture, or to kill all the San José Scale on a tree unless every particle of the bark is wet with the liquid. Fourth, the spray mixtures are sometimes not used at the strength recommended. Fifth, many men foolishly experiment with new mixtures instead of waiting until these have first been thoroughly tested by unprejudiced experimenters.

Before beginning to spray the machine must be put into good condition so that it will give good pressure and not leak. If two lines of hose are used, the one for the man on the ground should be from thirty to forty feet long, the other twelve to fifteen feet. The most satisfactory nozzles at the present time are those of the angle disc type. When the plates of these become much worn they should be replaced by new ones. If two nozzles are used on a T or a V they should not be set at a wide angle of divergence, but should be made to supplement each other and thus give a dense spray that will quickly wet the part being treated. Bamboo poles with aluminium rods inside are light and satisfactory if not roughly handled. A ten foot pole is about the right length for the man on the tower, and a six or eight foot one for the man on the ground. To prevent the drip running down the pole, a small rubber or leather disc about three or four inches in diameter cut out of an old shoe or rubber is helpful. It should be placed at the top of the rod just below the nozzle. Good pressure is necessary for speed and thoroughness. It should never be less than 100 pounds. With gasoline outfits about 150 to 200 pounds is high enough. Higher than 200 is liable to cause leaf injury. The mixture. The tank must, of course, be kept well agitated to prevent settling.

When spraying, especially in the first application, it is desirable to take advantage of the wind. A strong wind is great help, as it carries the spray right through the tree. If the wind is weak the trees are wide apple trees, it is necessary that the man on the ground go in underneath the tree to the far side, and shoot the spray up upon the branches and twigs or foliage and fruit, and gradually work his way back to the outside. This is the only way with these large trees to prevent the inner surface of upright twigs and small branches or later of the young fruits being unsprayed, for they will not be reached from the other side when the wind changes. It is on this inner side of young fruits that the scab nearly always first develops, hence the need of the step just indicated. In the case of San José Scale great care must be taken not to miss the tip of the branches. This is a very common fault with many sprayers.

In many instances there is too short a period to justify a person in waiting for changes of wind, hence under such circumstances the best method is to drive the team facing the wind and shoot the spray in at right angles to the row. This is a little slower, but if care is exercised is satisfactory. Moreover, by coming back and going up the other side, also against the wind, it enables a person to finish the trees the same day.

Thorough spraying requires great care and constant study. One should always follow some system with each tree, otherwise he will be missing parts here and there. Sometimes the best way is to take the tree branch by branch. At other times it is better to move the rod slowly up and down and work gradually from left to right or right to left, seeing that everything is covered as one goes. The angle on the nozzles permits the spray being directed first one way then back in the opposite, so that both sides of a branch or of fruits may be more easily covered. Often both sides may be covered by holding the nozzles against the wind and allowing this to drive the spray back. An apple tree capable of bearing five or six barrels of fruit will usually require from eight to ten gallons of spray, especially for the Codling Moth or for San José Scale.

DUSTING TREES FOR INSECTS AND DISEASES.

During the last few years considerable success has been obtained, especially in New York State, in treating trees with dust instead of liquid sprays. The dust used consisted of from 85 per cent. to 90 per cent. of very finely ground sulphur



Dusting fruit trees for insects and diseases.

and 10 per cent. to 15 per cent. of the powder form of arsenate of lead. It is applied by means of a blower driven by a gasoline engine. (See figure.) This is a very rapid and clean way of treating trees. At least twenty acres of large apple trees can be done in one day. The above substances, however, are useless against San José Scale, and also against Pear Psylla. Other dust materials in combat these are being manufactured, but their success is still uncertain. We ourselves have had only one year's trial of dusting, and are unable therefore to speak with certainty as to its merits. Should the method after further experiments prove satisfactory, it will lessen the fruit-grower's task greatly.

SPRAY CALENDARS.

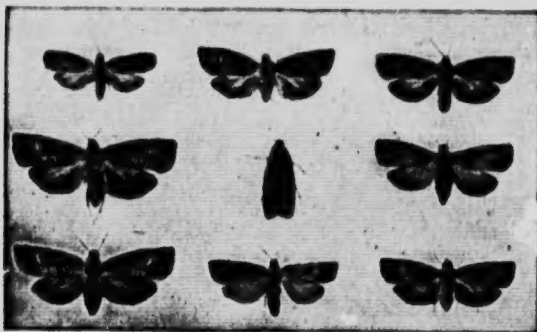
From time to time improved methods of combating insect pests and plant diseases are discovered. These new methods are incorporated in the Spray Calendar from year to year. Hence every fruit-grower should each spring write to the Fruit Branch, Toronto, and request a copy of the latest Spray Calendar, so that he may have the most up-to-date information available.

INSECTS ATTACKING THE APPLE.

CODLING MOTH (*Carpocapsa pomonella* Linnaeus).

Injuries from the Codling Moth larvæ are familiar to everybody, as these are the insects that cause by far the most of the worm-holes so commonly found in apples and pears.

The adult moth is greyish-brown with a well-marked golden brown patch near the apex of each front wing and with a wing expanse of about $\frac{3}{4}$ of an inch. The full grown larvæ are moderately stout, about $\frac{3}{4}$ of an inch long, white or often pinkish in colour with a brown head. Young larvæ have the head black.

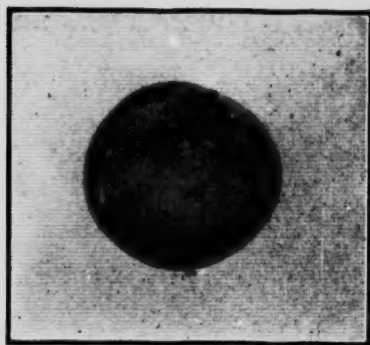


Adult Codling Moths, natural size. (After Slingerland.)



Full-grown larva about natural size. The dark spots on the body are not often so conspicuous. (Reduced from Simpson.)

They attack chiefly apples and pears though occasionally the other orchard fruits and haws are slightly infested. The injury is caused by the larvæ boring into the fruit, feeding on the pulp and seeds and causing the fruit either to fall prematurely or to be unfit for sale. Dropping of infested fruit begins early in the summer and continues to the time of picking. In some orchards, especially tho-



Castings at calyx end, showing clearly where larva entered the apple.



Work of lesser Apple-worm. (Original.)

in the warmer districts, the loss is often very heavy, sometimes 75 per cent. or upwards of the crop; in others, especially in the colder parts, it may be as low as 5 per cent. The average for the province in unsprayed orchards is probably between 30 and 40 per cent.

Life History. The winter is passed in the full grown larval stage in a little nest or cocoon under the shelter of the loose bark or in crevices or holes on the trunks or main branches of the trees, or in any other fairly dry, good hiding place near the apples from which the larvæ emerged. In spring the larvæ change to pupæ in their cocoons and the earliest moths begin to emerge soon after the blossoms fall. Emergence continues for a month or more, so that the earliest larvæ of this first brood may be more than a month older than the latest. A few days after their appearance the moths lay their eggs, placing most of them on the leaves and the rest on the fruit and twigs. The eggs hatch in a little over a week and the young larvæ almost at once seek the fruit. On finding it about 75 per cent. of them work their way into the interior through the calyx end, this being the easiest place of entrance at this stage of the fruit. Here they feed for a few days and then proceed to the core and feed on the seeds and pulp. In about 25 days the larvæ are full grown and make their way out of the fruit either by the same place as they entered or at some other point. The apples usually, but not always, fall before the larvæ leave them. After emergence the larvæ seek the sort of places mentioned above and make their cocoons. In the warmer part of the province many of these earliest first brood larvæ soon pupate and transform into moths which lay eggs for a second brood. The larvæ of this brood do not all appear at the same time but continue to hatch out for several weeks. As a large percentage of the new brood enter the fruit by the side instead of by the calyx they often cause great loss. When these larvæ are full grown they, along with the larvæ of the first brood that did not pupate, remain over winter in the larval stage in their cocoons.

Natural Enemies. The Downy Woodpecker and to a lesser extent the Hairy Woodpecker and the Chickadee destroy the larvæ and pupæ. These birds should, therefore, be encouraged to live in the orchard. A few meat bones hung out in winter for them to feed upon will help. The larvæ and adults of two or more species of beetles prey upon the Codling Moth larvæ and pupæ. Diseases attack them. Very wet springs or summers also help in control and the complete failure of a crop owing to early frosts or other causes will usually destroy nearly all of this pest in an orchard.

Methods of Control. The best, and in fact the only necessary, means of control is thorough spraying immediately after the blossoms have all or nearly all fallen. This spraying in the case of apples must be all done before the calyces close, because if this takes place it will be impossible to get the poison into them, and so the young larvæ on entering will not be killed, but if the poison is placed in the calyx before it is closed it remains there all summer and will kill the larvæ whenever they enter; so that a well-sprayed orchard will have almost no calyx-end wormy fruit.

As this is also the proper time to spray for the Apple and Pear Scab, the poison—arsenate of lead—should be used with the fungicide-lime-sulphur. The latter should be at the strength of 1,008 sp. gr. (1 gal. of the commercial lime-sulphur to 35 gals. of water), and the arsenate of lead at 2 lbs. of the paste form or 1 lb. of the powder form to every 40 gals. of the above strength of the lime-sulphur.

One cannot be too careful in spraying; to secure the best results in the double object of keeping off the Scab and killing the insects every calyx must be wet. It will not do merely to cover the tree with a fine mist and stop as soon as it begins to drip; the spraying must continue regardless of the dripping until the work is thor-

oughly done. This will often mean as high as 10 gals. or more per tree in the case of large apple trees that bloomed heavily. For these large trees a tower is nearly always a necessity. The nozzles should be of the angle type and have fairly coarse openings. High pressure will help greatly to drive the spray well through the tree and to make thorough work easier. Many advocate a second application about two weeks later but, if the first is well done, another will seldom be necessary; in fact one good application each year will, after two or three years almost annihilate the Codling Moth in the orchard or at least result in 95 per cent. annually of worm-free fruit. The destruction of the first brood means there will be no second brood or only the small number that may fly in from other orchards.

LESSER APPLE-WORM (*Enarmonia prunivora* Walsh).

The adult of this insect is a small, dark gray moth about half the size of the Codling Moth. Its larva resembles so closely the Codling Moth larva that very few fruit-growers even suspect that it is a different insect. The larva is, however, much smaller, being when full grown never more than $\frac{2}{5}$ of an inch long, whereas the Codling Moth larva is about $\frac{3}{4}$ of an inch. The color is a deep flesh or reddish, whereas that of the Codling Moth larva is either a white or light pinkish. An easier way to distinguish the two insects is by their work. The Codling Moth larva makes a definite hole in the fruit from which it throws out its castings and from this hole it makes a tunnel to the core where it feeds on the seeds and pulp; the Lesser Apple-worm larva as a rule leaves no definite hole, but feeds on the pulp just under the skin. This part of the surface then wrinkles, turns brown and forms a large blotch that badly disfigures the fruit. These blotches may occur on almost any part of the apple, but are usually most numerous at the calyx end.

Apples are much worse affected than any other orchard fruit, in fact it is only occasionally that plums, cherries and other fruits are infested at all. The native food plants of the insect evidently are the various kinds of haws. From these it has spread to the apple.

The total amount of injury to apples in the province is not nearly so great as that from the Codling Moth, probably not more than $\frac{1}{5}$ as great. We have been surprised, however, to find an occasional tree on which the amount of injury reached as high as 50 per cent.

Life History. The life history is so similar to the Codling Moth's that it need not be given. The only important difference is that there is apparently a full second brood. The larvæ of this brood are often found in the fruit even when the winter apples are being picked.

Methods of Control. Experience shows that the same spraying as for the Codling Moth will control this pest satisfactorily. Spraying should be supplemented by the cutting down of all hawthorn trees near the orchard, as the fruit of these is even more of a favorite with the insect than apples, and therefore these trees serve as a breeding place.

THE APPLE MAGGOT (*Rhagoletis pomonella* Walsh).

The Apple Maggot or Railroad Worm, as it is sometimes called, occurs here and there throughout almost all the fruit growing counties of the Province. Its chief ravages are usually confined to small orchards or individual trees in towns and villages or to badly neglected, unsprayed orchards in rural districts, especially if the soil in the latter is overgrown with weeds and long grass. Well cared for orchards that are properly sprayed are as a rule almost entirely free from this pest.

The adult insect is a pretty two-winged fly, a little smaller than a house-fly, and of a general blackish color, but with the eyes golden-green and the head and lower part of the legs yellow. The abdomen of the female is crossed by four con-



A female adult of the Apple Maggot on the fruit, natural size. (Original.)



A female adult of the Apple Maggot or Railroad Worm, much enlarged. (Drawing by Cory.)

spicuous white bands, and that of the male by three. Near the middle of the back is a small, distinct triangular white area. The wings have conspicuous black cross bands arranged on the definite plan shown in the illustration. The full grown larva



Apples showing the egg punctures of the Apple Maggot, natural size. (Original.)

is a small, legless and headless white maggot, about one-quarter of an inch long. One end of the body is blunt, and the other pointed. At the latter end are two little black hooks which are used to rasp and tear the pulp of the fruit and to free the juices, which are then absorbed through a small opening close to the hooks.

The food plants so far as known, are apples, haws and blueberries. Almost every variety of apple and some crabs may be attacked, but the common varieties worst infested are: Early Harvest, Sweet Bough, Astrachan, Golden Sweet, St. Lawrence, Gravenstein, Alexander, Wealthy, Cayuga, Snow, Tolman and Spy. Of these the sweet varieties suffer most, but the summer and early fall apples, owing to the fact that a much larger proportion of the larvæ mature in these than in later apples, are the chief breeding sources for the insect.

The injury to the fruit consists chiefly in the brown tunnels made in every direction by the maggots (hence the name Railroad Worm). The extraction of so much juice leaves the apples tough or woody and often unfit either for private use or for sale. In addition, the surface of the apple is disfigured by the small depressions produced where the eggs are laid and by the ridges that result where the larvæ feed close to the surface. Badly infested fall and winter apples usually drop prematurely. When the insects are abundant practically every apple in the orchard may be so severely infested as to be useless.



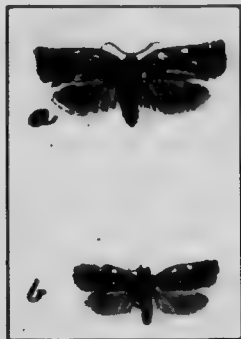
(a) Tunnel or burrow of Apple Maggot larva showing through the skin; (b) cross-section of a ripe apple infested with Apple Maggots, natural size. (Original.)

Life History. The winter is passed in the pupal stage in the soil a short distance below the surface. In the warmer parts of the Province the flies begin to emerge about the last week in June or the first week in July. In the colder parts emergence is a week or more later. Emergence continues throughout July and the most of August. In a week or more (the exact time is not known) after emergence the females begin to lay eggs in the fruit. The ovipositor resembles a bee-sting and is thrust to its full depth through the skin into the fruit and the egg deposited a short distance below the surface. The eggs hatch in about five days and the larvæ work their way through the apple, rasping the pulp and absorbing the juice. They do not grow rapidly until the fruit is nearly ripe, and never become full grown or emerge until the apples are over-ripe and often not until they have begun to decay. By this time of course all but a very rare apple will have fallen. After working their way out through the skin, the larvæ search for an easy place to enter the soil and pupate. There is practically only one brood a year, though some years in the warmer districts a very few adults emerge from the new pupæ and produce a second brood. By far the most of the pupæ that overwinter emerge the next July and August as adults, but a small percentage remain dormant in the soil over a second winter and emerge

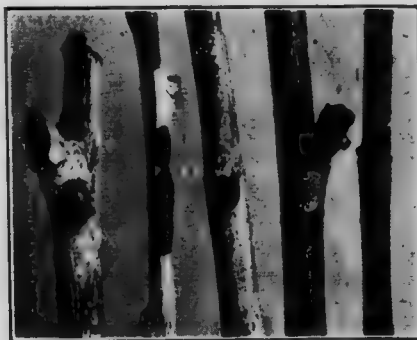
the succeeding summer. The adults have extensible mouth parts with a large, nearly circular structure at the apex. This they use as lips to gather their food. They may easily be observed moving about on the leaves and fruit with their mouth parts protruded, searching for juices or anything that they can devour. This manner of feeding is very important, for it enables us to take advantage of it to poison them before they can lay their eggs.

Methods of Control. By far the simplest and easiest way to control this pest is to spray the trees with 2 or 3 lbs. of arsenate of lead in 40 gallons of water. A gallon or a little less of cheap molasses may be added to this to sweeten it, but cage experiments and our experience with the closely allied Cherry Fruit-Flies tend to show that the molasses is not necessary. The first application should be made the last week in June in the warmer parts of the Province and about the end of the first week in July in the remaining parts. A second application should be given two weeks after the first. A fine nozzle may be used and the spray shot up into and upon the foliage. About 3 gallons per tree is sufficient for apple trees 30 years of age and upwards. At the first spraying all the trees should be treated but at the second the early varieties should be omitted as they are almost ready to pick. Every effort should be made to induce owners of nearby infested orchards to spray their trees also, because the flies move about much more than is usually supposed. For this reason spraying trees in a village or town will not control the pest unless all the trees for twenty rods or more around are also treated. All hawthorn trees close by should also be sprayed or cut down.

Another method of controlling the apple maggot is to gather up and destroy either by feeding to stock or by burning (not by burying) all ripe apples, especially all early varieties, soon after they fall. This method destroys the larvæ, but is very laborious and very few persons will carry it into effect. Sometimes the object can be attained by allowing hogs or other stock to run in the orchard.



(a) Adult female; (b) adult male of Fruit-tree Leaf-roller, both natural size. (Original.)



Egg-masses of Fruit-tree Leaf-roller. Those on the twigs to the left are unhatched, those to the right hatched, natural size. (Original.)

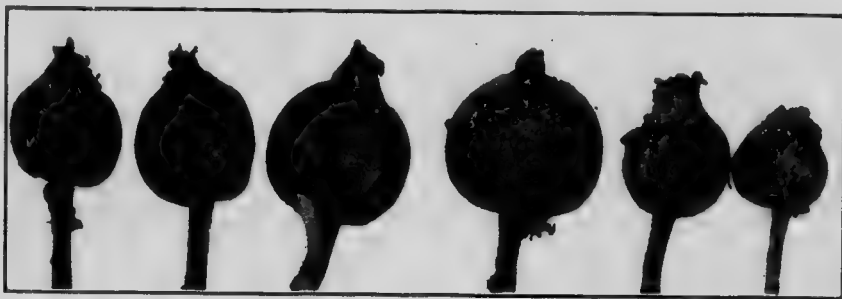
FRUIT-TREE LEAF ROLLER (*Tortrix argyrospila* Walker).

There are several species of Leaf-rollers the larvæ of which resemble each other closely, and have the same general habit of feeding and of rolling the leaves. By far the most destructive of these is the so-called Fruit-tree Leaf-roller. The adult of this insect is a moth with a wing expanse of nearly an inch. The front wings are rusty brown with several silvery-grey markings which are most prominent along

the front margin. The hind wings are light ashy-brown. The larvæ are somewhat slender caterpillars about an inch long when full grown and of a yellowish-green color with a brown head. In the younger stages the head is black.

The insect attacks all kinds of fruit trees, and also some shade and forest trees, but it does far the most damage to apples, and after these to pears and plums. An interesting peculiarity about it is that though it is found all over the fruit growing portion of the Province it has hitherto localized its attack to three or four orchards in widely separated districts. Other orchards close to these have so far been almost entirely uninjured. In the badly infested orchards the loss has been heavy, averaging about 50 per cent. of the crop. The chief injury is caused by the larvæ eating cavities out of the fruit while this is still small—not more than two-thirds of an inch in diameter—and causing it either to fall or to become badly deformed and unfit for sale. The foliage is also much eaten and presents a very tattered appearance.

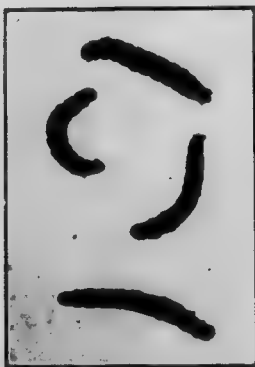
Life History. The winter is passed in the egg stage, the eggs being laid in small, brown, oval clusters one-quarter of an inch or less in length. The clusters



Fruit injured by larvæ of Fruit-tree Leaf-roller, natural size. (Original.)

are situated on the upper and lateral surfaces of the twigs and small branches. The eggs hatch in spring about the time the leaf-buds of the apple have opened. The tiny larvæ at once work their way into the opening buds and feed on the inner parts, and often retard the opening of the leaves by fastening them together with silken threads. They attack the fruit buds in the same way, and web together and destroy the opening blossoms. On the opened leaves they fold the one edge over and fasten it there with silken threads. It is from this rolling of the leaves they get their name of "Leaf-rollers." The larvæ hide inside the rolled leaf, sometimes feeding on the leaf itself and sometimes coming out to feed on other leaves and especially upon the fruit; for as soon as this appears they prefer it to everything else, and soon eat out large areas, thus forming cavities that may reach even the core. About the time the apples average two-thirds of an inch in diameter most of the larvæ are full grown and have begun to pupate. This takes place for the most part inside the rolled leaves, though many pupæ may also be found on the ground among the weeds and grass. In uncultivated or weedy orchards many larvæ drop by means of a silken thread to the ground and complete their development upon any kind of succulent plants they find there. In about two weeks the moths begin to emerge and egg laying soon commences. The moths hide during the day, darting away in a zigzag manner if disturbed. They fly around late in the evening and at night.

Methods of Control. The only successful way of controlling this pest is to spray the trees well with Scalecide or some other miscible oil at the strength recommended by the manufacturers for the San José Scale. Special care should be taken to see that every twig is well covered so that no eggs will be missed. The rest of the tree may be disregarded unless San José Scale is present. The spraying should be done just before the buds are ready to burst.



Larvæ of Fruit-tree Leaf-roller, all full grown and natural size. (Original.)



Apple leaves infested by Fruit-tree Leaf-rollers, natural size. (Original.)

Spraying with arsenate of lead, no matter how thoroughly done, fails to control the pest, partly because the larvæ in the early stages feed inside the opening leaves where the poison cannot reach them, and partly because when they become half grown or a little larger they are almost immune to the poison.

Keeping the orchard well cultivated in late May and early June should help by burying pupæ or crushing them. Chickens in the orchard would devour many larvæ and pupæ.

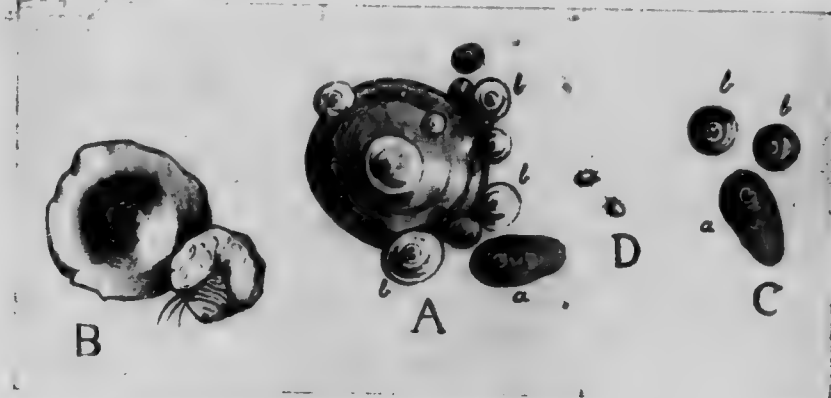
SAN JOSE SCALE (*Aspidiotus perniciosus* Comstock).

The San José Scale in Ontario does not, so far as is known at the time of writing, occur north of a line drawn from Sarnia to Toronto, and in this district is most abundant in the counties bordering on Lakes St. Clair and Erie and on the north shore of Lake Ontario. Wherever it can thrive it has proven itself far the most destructive of all orchard insects.

The full-grown female scale is nearly flat, circular, about the diameter of the head of a pin, ashy-brown in color with the central area usually yellowish, though often about the same color as the rest of the scale. The males are much smaller, oblong, and usually blackish in color. The most common stage, and the one by which the scale is most readily identified, is the so-called black immature stage. This is in size a mere dot, but when examined with a hand lens is seen to be circular and to have a little nipple in the centre with a depression or groove around it. These characteristics separate it from other closely allied scales. The scale insect in all cases lies beneath this scale covering, and is yellow, soft and pear-shaped.

The Scale in its various stages attacks all kinds of orchard trees except sour cherries, though Kieffer pears and some varieties of sweet cherries seem to be nearly immune. It also infests many shade trees and shrubs, such as mountain ash, hawthorn, Japanese quince, currants and roses.

The injury is caused by the tiny insects in almost countless numbers—often sufficient to cover completely the bark—inserting their long, slender, bristle-like mouth parts through the surface of the bark, leaves and fruit and extracting the sap. At the same time they seem to insert a poison which in many cases stains with a reddish color the inner bark and the part of the fruit around the insect itself. The result of these two kinds of injury is that not only is the fruit rendered unfit for sale, but the trees themselves are killed in from two to about six years, depending largely upon their size. Any severely attacked orchard is doomed to destruction in a short time if left untreated.

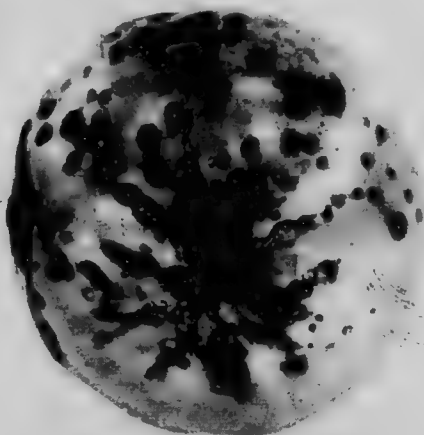


Various stages of San José Scale, all enlarged about fifteen times: A. Adult female scale with immature young of various stages settled down around or upon it; a, an adult male scale; b, b, b, three small black scales, winter stage. B. An adult female scale turned over, revealing the insect herself beneath with bristle-like mouth parts exposed. C. a, an adult male scale; b, b, two immature black winter stage scales. D. Young active larvæ soon after birth. Note the nipples and little grooves around them in A b, b, b, and in C b, b. (B redrawn from Alwood, the remainder original drawings by Miss A. Hearle.)

Life History. The winter is passed on the bark of the twigs, branches and trunks in the immature black stage described above. About May 24th the males are full grown and begin to come out from under their scale covering, fly around and fertilize the females. In a month, or about the last week of June, these have become full size and now begin to give birth to little butter-colored larvæ which run about for a day, then settle down, insert their sucking mouth parts, begin to feed and to cover themselves with the wax which forms their covering or scale. Each adult mother in the course of about 40 days may produce a total of 400 or more offspring. About the time the last of these are born the first are full-grown and beginning to produce a new generation. In Ontario we probably have two full broods in a year, and sometimes a partial third; so that the total offspring from one fertile female by the end of the season may reach into hundreds of thousands or possibly even to a million.

Up to the present time this insect has comparatively few insect enemies in our Province, and the chief controlling factor is evidently the weather, especially our severe winters, cold late springs and wet autumns.

Methods of Control. Spraying, if thoroughly done, will control this pest in the orchard. The best mixture up to the present is the lime-sulphur wash. This should be used at the strength of 1.035 sp. gr. or one gal. commercial lime-sulphur to 6 or 7 gals. of water. The spraying, especially of apple trees, may be done any time in the spring after the ground is fit to go upon up to the time when the leaves are the size of a ten-cent piece. At the latter date there will be a little burning, but not enough to do any serious damage. Spraying may also be done in the fall on warm days after the leaves have nearly all fallen. It is not wise to spray on a day when the thermometer is as low as freezing point. All badly infested trees should be marked and receive two applications. One of these may be given in the fall and the other in the spring, or both may be given in the spring. Before spraying every orchard should be carefully pruned and, if the trees are very tall, headed



San José Scale on apple, showing both the scales themselves and discoloration caused by them, natural size. (Original.)

back. This saves material and makes possible a good job. The loose bark should also be scraped off the trunks and large branches. In spraying the utmost care must be taken to see that every part of the tree is covered. This is no easy task, and requires a good outfit and constant watchfulness and intelligence. To insure thoroughness, some men in the Niagara District spray large trees from all four points of the compass. The thought in fighting this pest should not be to economize with the mixture, but to see that every particle of the tree from the topmost twig to the ground is thoroughly wet.

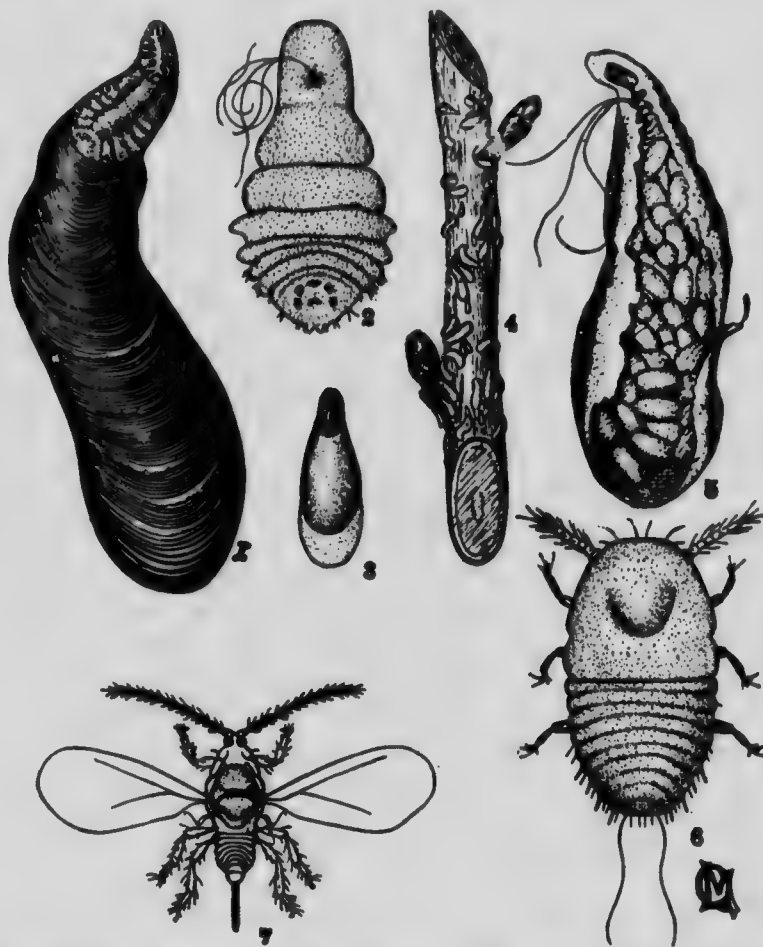
Soluble-sulphur (12½ lbs. to 40 gals. water) and likewise miscible oils, such as scalecide, have also given good results against the scale, but must be used before the buds have burst because of danger of burning.

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* Bouche).

The Oyster-Shell Scale is larger than the San José, and is easily distinguished from it by the fact that it is elongated, being about three times as long as broad, whereas the San José Scale is circular. A full-grown Oyster-Shell Scale, as shown in Fig. 16 is about ⅓ of an inch long, tapers towards one end and as the name sug-

gests, resembles in outline the shell of an oyster. Its color is nearly the same as that of the bark on which it is found.

This Scale is very common in all parts of the Province and attacks not only apple and other fruit trees, but also many shade and forest trees and many shrubs; apple trees, however, usually suffer most.



Various stages of the Oyster-shell Scale: 4. The scale slightly enlarged on a twig. The little holes in the scales indicate where parasites emerged. 1. The female scale very much enlarged, showing general shape. 5. A similar scale turned over to show the eggs beneath. The shrivelled body of the female herself is beyond the eggs at the small end. 2. A female removed from beneath the scale before she has laid her eggs. Note the bristle-like mouth parts similar to those of San José Scale. 3. A male scale. 6. Young larva, dorsal view. 7. Winged male. All except No. 4 much enlarged (after Sherman and Metcalf).

It is not nearly so prolific or so destructive as the San José Scale, and though it often kills individual branches, it comparatively rarely kills the whole tree. Badly infested trees are of course weakened and unable to bear good crops.

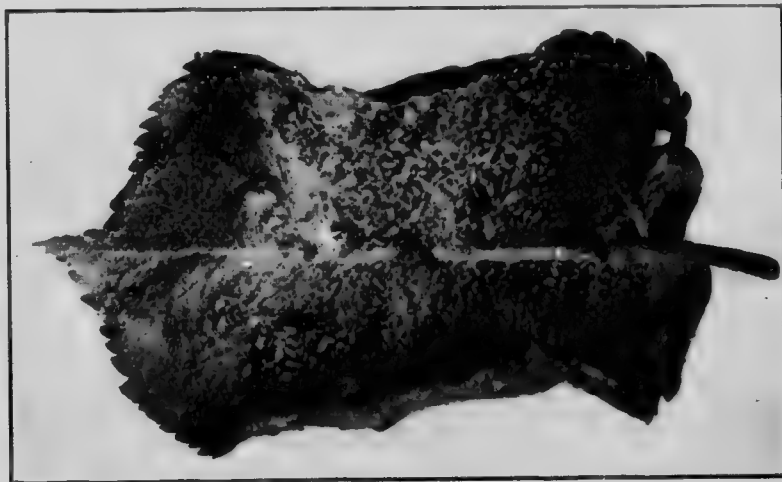
Life History. The insect winters in the egg state, there being an average of between 40 and 50 white eggs under each female scale. The eggs hatch about the

time the blossoms are falling from the apple trees. The tiny white or cream colored larvæ move around for about a day then settle down permanently, work their long, slender, bristle-like mouth parts through the bark, and gradually cover their bodies over with the wax that forms the protecting scale. The females become full-grown and begin to lay their eggs in August. Soon after all the eggs are laid the insects themselves die. There is only one brood a year in Ontario.

Methods of Control. Thorough spraying each year with lime-sulphur (strength 1.030 sp. gr. or 1 gal. commercial lime-sulphur diluted with 8 or 9 gals. of water) any time in spring from a week or so before the buds begin to burst until the little leaflets are the size of a ten-cent piece will soon completely control this scale. The regular Codling Moth spray with arsenate of lead and lime-sulphur, will help by killing many of the larvæ while they are still small and delicate. Dead scales, of course, will remain on the trees for a year or two after they have been killed. Weakened trees can be assisted to recover their vigor by cultivation and the use of fertilizers.

APHIDS—A GENERAL DESCRIPTION.

Aphids are tiny, soft-bodied, usually sluggish insects. There are a great many species, and so common are they that most of our plants are attacked by at least one species and sometimes by several. The different species often differ greatly in color: some are green, others black, others red, others brown, and so on. They all obtain their food by sucking the juices out of the plants after first penetrating the epidermis with their sharp needle-like lances. As they feed they exude from time to time a clear, sweetish liquid called honey-dew, of which ants are very fond. When



Dense colony of Rosy Aphids on under-surface of an apple leaf. Three ladybird beetle larvæ may be seen among them. All are natural size. (Original.)

the aphids are very abundant, such a large quantity of honey-dew is exuded that it covers the leaves and fruit and causes them to become sticky and later a dirty sooty color, due to a black fungus which grows in the honey-dew. There are many generations each year, some species having thirteen or even more. Each generation except the last consists entirely of females. The last is composed of true sexual

forms, males and females. These mate and the females lay eggs for winter and then die. In all the preceding generations living young instead of eggs are produced, and that too without the presence of any males. The first generation in the spring is composed entirely of wingless forms, but in the later generations winged forms also appear. These can fly from tree to tree and so distribute the species. Some, but not all, species have what is known as an alternate host plant or plants; that is they remain for one or more generations in the spring on the plant on which they over-wintered, and then a winged generation appears which migrates to some other kind of plant and lives and reproduces on this until autumn, when another winged generation is produced, which migrates back to the original host.

The rate at which aphids can multiply is marvellous, and far surpasses that of any other common orchard pest. This is due to the fact that there are so many broods each year, and that each brood except the last is entirely composed of females. Very fortunately for us these insects have many enemies which do a great service in helping to control them. The chief of these are Ladybird beetles and their larvæ, Syrphus Fly and Lacewing larvæ and tiny four-winged parasites. In addition to these, disease often destroys countless numbers, and weather has also a great influence. Cool, moist weather seems to be favorable and hot, fine weather unfavorable to orchard aphids.

APHIDS OF THE APPLE.

There are three common species of aphids that attack the foliage and fruit of the apple, and one species known as the Woolly Aphis that attacks the bark and roots. Of the first three species two are green and the other usually purplish or pinkish with a whitish bloom over its body. Because of its pink or purplish color this last species is known as the Rosy Aphis—*Aphis (sorbi) malifoliae*. Of the two green species the less important is often known as the European Grain Aphis (*Aphis avenæ*) because it is a European species, and has as its alternate host plants wheat, oats and rye, as well as several kinds of grasses. The third species, perhaps because it has no alternate host plant, but remains on the apple throughout the year, is usually called the Apple Aphis or the Apple Leaf-Aphis (*Aphis pomi*). The Rosy Aphis has as its alternate host plants the various kinds of plantains, especially rib-grass.

Aphis avenæ is some years abundant on the buds, young leaves and blossoms, but apparently does little permanent injury, probably because it usually migrates to its other host plants early in the season about the time the blossoms are out in bloom, not returning to the orchard until the fruit is mature in autumn. The Rosy Aphis seems usually to be responsible for most of the injury up to about the first of July, after which it migrates to its alternate host plants for the rest of the summer and early autumn. Consequently any further damage from aphids is caused almost entirely by *Aphis pomi*, which, as we have said, has no alternate host. This insect of course has also a share in the losses caused in the early part of season.

On bearing trees most of the damage done by the various species is on the lower branches. On these some years great numbers of the aphids attack the leaves, tender twigs and fruit, causing the leaves to curl, turn yellow and sometimes die, and the fruit to become dwarfed, woody and often pitted, and to hang on the branches in clusters. Such fruit is unfit either to sell or use.

Young trees and nursery stock commonly suffer more than old trees, be-

cause the aphids seem to prefer their tenderer foliage. Where badly infested these trees have their growth stopped and sometimes the upper parts of the branches are either killed or much weakened by the extraction of the sap. The new growth is the part of these most attacked.

Pears as well as apples may be attacked, but are seldom badly infested or suffer loss worth mentioning.

All the above species winter in the egg state. The eggs are laid on the bark of the branches and water sprouts, often being placed around the buds or in crevices. Hatching of these is usually completed in spring by about the time the leaf-buds have begun to burst, those of *Aphis avenæ* being usually a few days earlier in hatching than others.



Cluster of small deformed apples, showing the effect of *A. avenæ* attacks in June and July, about two-thirds natural size. (See page 1)

If at this date the buds are examined, the young aphids can easily be seen without the aid of a magnifying glass. They are then of course very small, but this very fact, together with their exposed position shows that this is a good time in which to destroy them by spraying.

Methods of Control. Postpone the regular dormant spray with lime-sulphur—strength 1.030 sp. gr. or for San José Scale 1.035, (1.030 sp. gr. = 1 gal. commercial lime-sulphur to 9 gals. of water: 1.035 sp. gr. = 1 gal. to about 7), until the buds are beginning to burst and then add to the mixture a tobacco extract, either Black Leaf 40 or Grasselli's Nicotine-sulphate 40 per cent.. The amount of either substance to use is printed on the can in which the extract is bought. The spraying of course should be done so as to insure that every bud is well covered. If spraying is postponed until the foliage is out it is very doubtful whether it pays because many of the aphids are then so situated among the leaves that they cannot be reached.

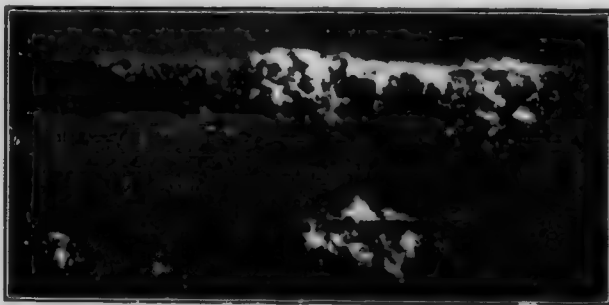
In many bearing orchards in Ontario aphids are seldom abundant enough to do much injury, and where this is the case it is doubtful whether it would pay to use the tobacco extract, especially as it is costly. Other orchards in different situations suffer considerable loss almost every year, and these it would clearly be wise to treat as described above.

Young trees being subject to severe infestation throughout the season would be benefited by the same treatment as given for bearing trees, but they should also be examined from time to time during the summer to see whether they have become re-infested, and if so should at once be treated with the tobacco extract combined with from 1 to 2 lbs. of common soap sliced and dissolved in boiling rain water and added to every 40 gals. of the liquid, the lime-sulphur being omitted. Instead of the tobacco extract and soap, whale oil soap 1 lb. to 6 gal. of rain water is sometimes used. Kerosene emulsion, if properly made, is also effective. (See Spray Calendar.)

Nursery trees may receive the same treatment as small orchard trees, but in many cases the best results on them are to be obtained by carrying the mixture in a large bucket and bending the top of each infested tree over into it, thus insuring that every aphid will be reached.

WOOLLY APHIS (*Eriosoma lanigera* Hausmann).

This aphid attacks the bark and roots, doing very little injury to the foliage of the apple. It can easily be identified by its conspicuous, white, waxy covering, which looks like a little tuft of wool or of cotton-batting. If the covering be removed the insect beneath is seen to be brown or reddish-brown. In parts of the United States the Woolly Aphis is considered a great pest because of the injury it does to the roots of the young trees. The root infesting individuals by their sucking



Woolly Aphids clustered on tender apple shoot, natural size. (Original.)

cause small nodules or swellings which ultimately kill the smaller roots and so either destroy or greatly weaken the tree. Fortunately, in Ontario this root injury is almost entirely absent, and it is only the insects above ground that do any appreciable damage, but even these do not cause much harm. Occasionally a few trees in an orchard will have a good many small branches, water-suckers and wounded areas heavily infested with the insects. In such cases on the branches and water-suckers little swellings which later may rupture and cause small cankers are produced while around the margins of infested wounded areas there is formed a conspicuous callous. These injuries however, rarely do much permanent damage to the tree itself.

Life History. This species has a somewhat complicated life history, which we need not go into further than to say that while some few individuals winter on the apple, the most of them migrate to elm trees, where the winter is passed in the egg stage on the bark. In the spring the first two generations from these eggs feed on the elm leaves, causing them to become rosetted, but the third generation flies back to the apple trees and serves as the chief source of re-infestation of these.

Methods of Control. Wherever the insects are abundant on small trees, the easiest way to treat them probably is to take a whitewash or paint-brush and a pailful of whale oil soap or even common laundry soap (either of them at the strength of 1 lb. to about 5 gals. of rain water), and with the brush wash the aphids off the branches or trunks. On larger trees a spray machine may be used, but the nozzle must be held close to the insects, so that the spray will break through the waxy covering and reach the insect's body beneath. Only the infested parts of the tree should be sprayed.

LEAF-BUGS (*Mirida*).

Four species of Leaf-bugs have been found attacking the foliage and fruit of apples. These are *Heterocordytus malinus* Reuter, *Lygidea mendax* Reuter, *Neurocolpus nubilus* Say and *Paracalocoris colon* Say. They occur to some extent in many orchards in the Province, but are scarcely important enough to justify a detailed account of each. In all cases it is the nymphs that do nearly all the damage. The nymphs of the first two species are red; those of *Neurocolpus nubilus* are greenish



Work of Mirids or Leaf-bugs on apples. This is done when the apples are very small. (Original.)

mottled with dull red; and those of *Paracalocoris colon* reddish-brown with some whitish markings. The nymphs of all species when first hatched are only about one-tenth of an inch long, but when full grown and ready to change to adults are nearly one-quarter of an inch. They all have sucking mouth parts.

The injury is caused by the nymphs feeding upon the tender foliage and the terminal portions of the new growth, and also upon the young fruits from when they begin to form until they are half an inch in diameter.

The injury to the leaves and new growth is not usually of much importance: the chief injury is done to the fruit. When the nymphs penetrate this with their sharp beaks and suck out the juices they so injure some of it that it drops, and the rest often becomes badly deformed by the depressions and elevations that result from the feeding.



An adult Leaf-bug (*Neurocolpus nubilus*), and two nearly full-grown nymphs, natural size. (Original.)

Life History. The winter is passed in all cases in the egg stage. The eggs are situated in the bark of the twigs or small branches. Those of the first two species usually hatch before the blossoms burst, but those of *Neurocolpus nubilus* do not hatch until after the blossoms have fallen. The date of the hatching of the other species is unknown to the writer, but is probably about the time the blossoms are open. The nymphs feed as described above and become full grown in about a month. Adults in at least some cases live for several weeks and lay their eggs, usually singly, in the bark as said above. There is just one generation a year.

Methods of Control. The red nymphs of the first two species may be killed by adding a tobacco extract of the same strength as for Aphids to the spray just before the blossoms open, or if the infestation is severe, to both this spray and the one after the blossoms fall. The nymphs of *Neurocolpus nubilus* hatch too late for these sprays and are immune or almost immune to tobacco, but can be killed by thorough spraying with a sticky soap—common laundry soap—at the strength of 1 lb. to 10 gals. of rain water. The other species has not been known to occur in sufficient numbers to justify spraying for it.

APPLE TENT-CATERPILLAR (*Malacosoma americana* Fabricius).

Webs of the Tent-Caterpillars are conspicuous objects in the spring of the year. They may be found on the twigs of many kinds of trees, including not only the various kinds of fruit trees, but also many kinds of forest trees, especially wild



Tent-caterpillar: Male
Moth, natural size.



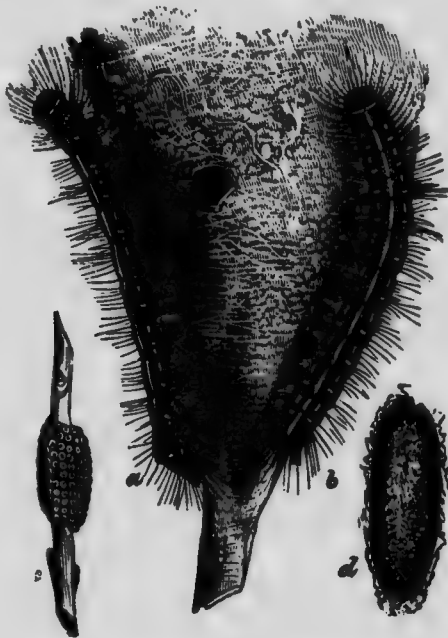
Tent-caterpillar: Female Moth,
natural size.

cherries. Outbreaks of this insect occur periodically. For ten or fifteen years the country is almost free of them, then for a few years is overrun by them; then recur the years of comparative freedom, followed again by another outbreak.

When the caterpillars are very abundant in the orchard they may defoliate practically every tree. Sometimes this defoliation takes place two or three years in succession. The result is that not only is the crop lost each year, but the trees are left in a greatly weakened condition and sometimes succumb to the strain of a severe winter.

The full-grown larvæ are about two inches long, of a general brownish-black color with a conspicuous white stripe down the middle of the back. The adults are reddish-brown moths with a wing expanse of from 1 to 1½ inches. The front wings have two white transverse bands parallel to the outer margin.

Life History. The winter is passed in the egg stage on the twigs of the trees, the eggs being in clusters that encircle or nearly encircle the twig. Each cluster is one-half to two-thirds of an inch long, elliptical in outline and a little darker in color than the bark. The eggs hatch about the time the apple buds are



a and b, Apple Tree Tent-caterpillars on their web; c, egg-cluster; d cocoon.



Forest Tent-caterpillar: (a) egg mass, (b) moth, (c) vertical view of much enlarged egg, (d) side view of eggs much enlarged.



Forest Tent-caterpillar.

ready to burst. The young larvæ from each egg cluster remain together in a colony and soon construct a little web, increasing in size as they grow and need more room. Into this they retire at night and part of the day when not feeding. They feed upon the foliage near their web, gradually extending their range as necessity demands. In June they become full grown and then wander in various directions from the web and often from the tree itself in search of sheltered places in which to spin their cocoons and pupate. The cocoons are elliptical and made of white silken threads covered over with a yellowish powder. During the latter part of June and the first two weeks of July the adults emerge, lay their eggs on the twigs and soon die. There is only one brood each year.

Many parasites and one or more destructive diseases play a very important part in the control of this pest. Birds also destroy many of them. The fact is

that we owe to all these friends the disappearance of the great hosts of these insects before they have time to work irreparable ruin to many orchards and forest trees.

Methods of Control. Thorough spraying of the trees very soon after the leaves have begun to expand with either 3 lbs. of arsenate of lead or $\frac{1}{4}$ to $\frac{1}{2}$ lb. of Paris green to 40 gals. of water will destroy the caterpillars. They should always be treated while still small and easily killed and before they have been able to do much damage. Orchards that received the regular three sprayings indicated in the Spray Calendar never suffer any loss from this pest no matter what the surroundings may be. It has been shown by Mr. E. P. Bradt, District Representative for Dundas County, that the first of these sprayings, the so-called dormant spray, if applied when the buds are bursting, will, without any poison, kill over 80 per cent. of the young caterpillars. Cutting down wild cherry and fruit trees along the fences and roadsides will help some, as will also the collecting and destroying of egg masses.

FOREST TENT-CATERPILLAR (*Malacosoma disstria* Hubner).

This insect is very closely allied to the Apple Tent-Caterpillar, and like it is abundant only periodically. Though at times very numerous and destructive in orchards, it is also, as its name suggests, a great forest pest, especially in maple woods, which it sometimes almost defoliates.

There are several points by which the two species may be easily distinguished: The moth of Apple Tent-Caterpillar has two white cross-bands on each front wing; that on the Forest-Tent has two brown cross-bands. The Apple-Tent larva has a white stripe down the middle of the back; the Forest larva has a row of white dots. The larvæ of the Apple species form a definite web or tent; those of the Forest do not, but merely spin silken threads here and there where they feed or travel. The cocoons of the Forest species are often spun in a folded leaf or cluster of leaves; those of the Apple species are not in leaves, but in any other good hiding place, such as the underside of fence rails or boards.

The life history of the two species is very similar, as are also the natural enemies and the artificial means of control.

CANKER-WORMS.

Two species of Canker-Worms infest our orchards and forests. These are the Fall Canker-Worm *Alsophila pometaria* Harris), and the Spring Canker-Worm (*Palearctia vernata* Peck). The terms "fall" and "spring" are given because the moths of the former emerge chiefly in the fall, while those of the latter emerge in spring.

The larvæ of both species are slender and of a general blackish or brownish or sometimes green color, with lighter stripes down the back and sides. When full grown they are about an inch long. Both species move from place to place with a looping gait, due to the fact that they have fewer hind legs (prolegs) than most caterpillars. The Spring Canker-worm has only two pairs of these hind legs, the Fall Canker-worm has three pairs, though the first of these is not fully developed. When disturbed both species drop down on a silken thread. The moths of the two species are a light greyish-brown color, with slender bodies. They resemble each other closely. The male moths have wings, but the females are wingless.

It is only once in a long time that we have a very bad outbreak of these pests, but when they do become numerous they often remain so for about five years, after

which they become scarce again. In years of great abundance they are very destructive and not infrequently completely defoliate whole orchards and numerous



(a) Spring Canker-worm, male adult; (b) Fall Canker-worm, male adult, both natural size. (Original.)



Female adults of Fall Canker-worm, natural size. (Original.) Spring Canker-worm female adults resemble these very closely.

forest trees as well. They feed on most orchard trees and also on many deciduous forest trees, but their favorites seem to be the apple, elm, and basswood.



Full-grown Fall Canker-worms and their work, natural size. (Original.)

Life History. The moths of the Fall Canker-worm appear for the most part in fall, in November, and the eggs are then laid in close irregular clusters on the

trunks and branches. Each egg is set on its end and looks like a diminutive pail or flower pot. The cluster is nearly the color of the bark and is not covered over with any protecting substance. A few moths of this species do not emerge until early spring, and lay their eggs then. The Spring Canker-worm moths emerge in March and April and lay their eggs in more concealed places on the bark, such as under loose bark or in crevices. These are in a looser cluster and are oval in shape. The eggs of both species hatch about the time the apple buds are bursting and the young larvæ feed on the foliage as soon as it appears. They are full grown early in June and then drop to the ground where they pupate in the soil. There is only one brood a year.

Birds are said to play an important part in the control of these pests. There are also some parasites and other natural foes that help.

Methods of Control. 1. Experience shows that clean cultivation, extending as far into June as is safe, has a great effect in lessening the numbers of these insects.

2. Thorough spraying with arsenate of lead about 3 lbs. to 40 gallons of liquid will destroy the young larvæ. The best method is to postpone the dormant spray until the apple leaves are about half an inch long and then add to it the arsenate of lead. This should be followed by the regular spray just before the blossoms open and immediately after they fall. (For these see Spray Calendar.)

Shade trees may be protected from infestation by putting a band of tangle-foot on the trunk a foot or so above the ground. A band of cotton-batting about six inches wide, fastened with a string around the centre, and the upper half then turned down, will also prove effective except in very wet weather. These bands should be put on about the middle of October for the Fall Canker-worms and about the end of February for the Spring Canker-worms. They prevent the wingless females from climbing the trees after they emerge from the ground. They also keep down any larvæ that hatch from eggs laid below the band.

BUD-MOTH (*Imetocera ocellana* Schiffermüller).

The Bud-moth is a very common insect in Ontario, and causes considerable loss, but not nearly so much as in Nova Scotia, where it is probably the most destructive biting insect of the orchard.



Bud-moth, natural size.
(Reduced from W. E. Britton.)

The adult is a greyish-brown moth with a wing expanse of about half an inch. Across the middle portion of each front wing is a broad, greyish white, irregular area, occupying about one-third of the whole wing. The larvæ are the same shape as a Codling Moth larva, but are smaller, being only $\frac{2}{5}$ of an inch long when full grown. They are reddish-brown and have glossy black heads.

The larvæ attack all kinds of fruit trees and also some other trees and shrubs. The injury is done in several ways: (1) The over-wintering larvæ in early spring bore into the green tips of the opening buds and feed upon the tender tissues within. (2) They fasten together the opening leaflets in the same manner as leaf-rollers, thus retarding their development, and feed inside upon the inner

portion. (3) Fruit-buds are attacked in the same way as leaf-buds and the stamens and pistils often destroyed. (4) After the leaves have expanded, the larvæ commonly fold over part of the margin, fasten it securely, and each lives during the day in the little tunnel or nest thus made, going out to feed upon surrounding leaves in the evening or at night. Often the stem of such a leaf is nearly cut through, thus causing it to die. Partly to prevent the leaf's dropping and partly to secure still more shelter and food close at hand, the larva very commonly attaches it to one or more neighboring leaves. (5) Later in the season the young larvæ of the new brood are found on the under surface of the leaves, where they construct a fine whitish web alongside the midrib or one of the main veins and feed under this covering. Here they remove all the green tissues, leaving only the fine network of veins. (6) Not infrequently these second brood larvæ eat little holes



Work of Bud-moth larvæ, natural size. (Original.)

through the skin of an apple, where a leaf touches it and thus gives them the necessary cover and protection. Such injury is often attributed to Codling Moth larvæ.

Life History.—The winter is passed in the larval stage, the larvæ being only about one-third grown, and being hidden in little inconspicuous cases situated in the crotches of twigs or beside a bud or at other places on the bark. As soon as the buds are beginning to show green at the tip the larvæ leave their winter quarters, make their way to the buds and bore into them; later they feed on the fruit buds, leaves and other parts, as mentioned above. About the middle of June or a week or so after the blossoms are all off they become full grown and change into pupæ in their little nests or hiding places in the leaves. Towards the end of June and during the first half of July adults emerge. After a few days eggs are laid on the leaves. The young larvæ from these feed as described above, on the

foliage and fruit. Early in September they cease feeding and go into winter quarters.

Methods of Control.—Observations in well-sprayed orchards show that if the regular three-spray applications recommended in the spray calendar for apples are applied systematically, year after year, there will soon be no trouble from Bud-moth. Of these applications the one just before the blossoms open is the most important. If this can be applied with high pressure as a driving spray, it will be more effective in reaching and controlling the pest.

CIGAR CASE-BEARER (*Coleophora fletcherella* Fernald).

The Cigar Case-bearer can be identified easily by the cigar-like shape and color of the little protecting case in which the larva conceals itself, both when resting and when feeding. These cases are about one-third of an inch long, and may readily be found in May, June and early July on the leaves and twigs of apple and pear trees, especially in uncared-for orchards.

The injury is caused by the mining habits of the larva, which eats a little hole through the upper surface of the leaf, and then as a leaf-miner devours all the green tissues between the two surfaces as far as it can reach in every direction without letting go its case. Sometimes there are many of these brown mined areas on a single leaf, and if the pest is abundant the foliage may be much injured. Occasionally little holes are eaten through the skin of young fruits, apparently without leaving any permanent damage. In spite of the fact that this insect some years renders unsprayed orchards quite unsightly because of the injured foliage, it can scarcely be said to be a very important pest and plays a comparatively small part in commercial orchards.

Life History. The winter is passed in the larval stage, the larva being very small, not more than about one-quarter grown, and enclosed in a little curved brown case. These are usually situated in the axils of branches. When the buds are nearly ready to burst in spring the larvæ, still protected by their cases, move from winter quarters to the green tips of the buds and begin feeding on these, later, as already said, they make mined areas in the leaves and even feed a little on the fruit. Their little curved cases are first enlarged and then abandoned for the cigar-shaped larger cases. The larvæ are full grown towards the end of June, then attach their cases firmly to a leaf or to the bark and pupate inside them. The adults, which are delicate steel-grey moths, with a wing expanse of less than half an inch, emerge throughout most of July. Eggs are laid singly on the leaves and the larvæ, in hatching from these, act for a few days as leaf-miners without any case, then construct small curved cases, and early in September move into their winter quarters.

Methods of Control. Orchards that receive the regular three sprayings as stated in the Spray Calendar, are very little troubled by this pest. Of these three applications the one just before the blossoms open seems to be far the most important in destroying this insect.

PISTOL CASE-BEARER (*Coleophora malivorella* Riley).

The Pistol Case-bearer is a very near relative of the Cigar Case-bearer, but may easily be distinguished from it by its case being shaped like a pistol instead of a cigar. In Ontario it seems to be almost everywhere much less common

than the Cigar Case-bearer. It attacks the foliage and occasionally the young fruit. On the latter it makes the same sort of small feeding punctures as the other species; but on the leaves, instead of acting as a leaf-miner, it eats holes,



(a) Cigar Case-bearers and their work on apple leaves, (b) Pistol Case-bearer and its work on young fruit, natural size. (Original.)



Green Fruit-worms and their work on apples, natural size. (After Slingerland and Crosby.)

sometimes skeletonizing the leaves or destroying all but the main veins. Apples are its favorite food plant.

The life history is very similar to that of the Cigar Case-bearer. Control measures are also the same.

GREEN FRUIT-WORMS (*Xylina* spp.).

There are several species of these Fruit-worms, but the larvæ resemble each other closely, and are stout, pale green caterpillars, a little more than an inch long when full grown. The head is a very light shade of green, almost white, and down the middle of the back and each side is a cream-colored stripe. These characteristics, and the fact that they do not lower themselves with a silken thread, easily distinguish them from the Leaf-roller larvæ. The adults are stout, greyish-brown moths, nearly related to and closely resembling the moths of Cutworms.

The injury is done by the larvæ. These feed on the leaves in spring until the fruit begins to form, then they attack this and eat deep holes about the thickness of a lead pencil into it, thus ruining the fruit and often causing it to fall. Fortunately, the larvæ are very seldom abundant enough to do much harm.

All kinds of orchard fruits are attacked. The larvæ feed also on the foliage of many deciduous forest trees.

Life History. The moths lay their eggs singly on the bark of the twigs and small branches in spring. The larvæ on hatching feed upon the developing leaves and later upon the young fruit. They are full grown soon after the blossoms drop, and then enter the ground to pupate. In the autumn the moths appear and hibernate in sheltered places. There is only one generation a year.

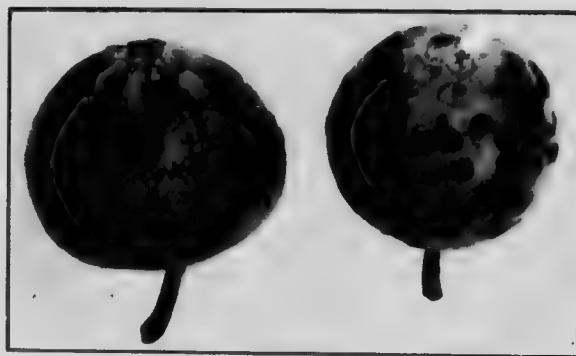
Methods of Control. No special measures are necessary for this pest further than the regular sprayings indicated in the Spray Calendar. Of these the one before the blossoms is the most effective.

WHITE-MARKED TUSOCK-MOTH (*Hemerocampa leucostigma* Smith & Abbott).

From time to time this moth's larvæ, which are great enemies of shade trees in cities, become abundant in orchards and injure not only the foliage of apples, plums and other fruit trees, but also often eat shallow areas out of apples themselves. A brown callous forms over the injured places, but leaves the fruit disfigured.



Larvæ of White-marked Tussock-moth, nearly full grown. (Original.)



Work on apples of the larvæ of the White-marked Tussock-moth, natural size. (Original.)

The larvæ are pretty, hairy caterpillars, about $1\frac{1}{2}$ inches long when full grown. They can easily be recognized by the red head, the two long black tufts of hair at the anterior end and a single tuft at the posterior and the four dense, cream-colored short tufts of hair on the back.

Life History. The winter is passed in the egg stage. The eggs are laid in a mass and are covered over with a white froth-like substance. Egg masses are usually situated on the bark of the trunk or larger branches, though they may sometimes be on a leaf. They hatch in June, usually a couple of weeks or more after the apple blossoms have fallen. The larvæ, as already mentioned, feed on foliage, preferably young shoots or suckers from the main branches, and also on the fruit of apples. Some are full-grown early in July, others not till well on in August. When full-grown they spin a thin silken cocoon in the places where we have said the eggs are placed. In these cocoons they pupate. In a couple of weeks the moths emerge. The males have ashy-grey wings and fly about, but the females are light grey and have no wings. They remain beside the cocoon until fertilized by the males, then lay their eggs and soon after die. There appears to be only one generation a year in this province.

Methods of Control. The young caterpillars can be killed by spraying with 2 or 3 lbs. arsenate of lead in 40 gals. of water, or of Bordeaux mixture or dilute

lime-sulphur; but it is cheaper and more satisfactory, if the presence of egg masses shows there is likely to be a considerable number of the larvæ, to go around and remove and destroy the egg masses. Mr. W. A. Biggar, the provincial fruit pests inspector, informs the writer that a narrow wire brush about an inch wide and five or six inches long, fastened to a bamboo pole, is very satisfactory for removing egg masses from the higher branches. Some use a broad hook, like a bent spoon, instead of the brush. The egg masses are most easily seen when the leaves are off the trees. Some advocate destroying the eggs on tall trees by saturating them with crude coal-tar creosote, darkened by the addition of a little lampblack.

FALL WEB-WORM (*Hyphantria cunea Drury*).

During August and September large webs, often a yard long, may be seen here and there on trees throughout the orchard and also on many kinds of shade and forest trees. These webs are caused by the so-called Fall Web-worms. The webs of the Apple Tent-caterpillar can be easily distinguished from these by the fact that they are made in the early part of the season and are much smaller.

The adults of the Fall Web-worms are pretty little white moths, with a wing expanse of about an inch. The larvæ are greyish-brown caterpillars about one inch long when full grown, and thinly covered with tufts of long hair.



Fall web-worm adults and egg mass on a portion of a leaf, natural size. (Original.)



Fall Web-worm: full-grown larva, slightly enlarged. (Adapted after Slingerland and Crosby.)

Life History.—The winter is passed in the pupal stage in the ground or under rubbish. In the spring, towards the end of June, the moths begin to emerge. These lay their eggs in a dense cluster on the leaves. On hatching, the young larvæ all feed together, remove the green substance of the leaves, and leave only a network of veins. Soon they cover themselves over with a web and extend this as they require more food. They feed under cover of the web until nearly full grown, and then wander around in various directions and finally select a place in which to pupate. There is only one generation in a year.

Fortunately natural enemies are so effective in the case of this insect that all that is necessary is to examine the trees from time to time, and whenever an infested branch is seen, cut it off at once and destroy the caterpillars. Usually this can be done most easily by trampling them under foot. The branches or twigs should be removed while the webs are still small and before many leaves have been destroyed. Spraying is not necessary.

BUFFALO TREE-HOPPER (*Ceresa bubalus* Fabricius).

The Buffalo Tree-hopper is found in all the fruit-growing districts of the province, and sometimes does much injury, especially to young apple and pear trees. The injury is almost entirely due to the egg-laying habits of the insect. The eggs are deposited on the upper side of the smaller branches and also in the case of young trees on the trunks. In each instance before laying her eggs the female, with her sword-like ovipositor, makes a small, more or less crescent-shaped cut through the bark and then places the eggs in this. As soon as this is done, she makes another similar slit close to and just opposite the first, and deposits eggs in it too. The wood beneath these two slits does not heal, but causes an ugly scar which continues to enlarge for several years. As the whole upper surface of the branches and also, in exceptional cases, the trunks of young trees may be almost covered with these slits and scars, it naturally follows that such trees are weakened, dwarfed and more likely to succumb to severe winters or disease than uninjured trees. Some forest trees and shrubs are also infested.



Buffalo Tree-hopper adults and egg scars on branch, natural size. (Original.)

The adult Tree-hopper is about one-third of an inch long, moderately stout, triangular in front with the two upper angles projecting somewhat and suggesting the name "Buffalo Tree-hopper." The upper surface of the body slopes gradually back from the front to rear, so that from a side view also the insect has a triangular appearance. The general color is pale green.

Life History. The winter is passed in the egg stage in the slits of the bark. The eggs hatch about the time the leaf buds burst. The young nymphs after a very short time go to the ground, where they feed on almost any kind of succulent weeds, sucking the juices out of these. In July they begin to transform into adults which soon fly to trees and shrubs to lay their eggs. Oviposition continues all through August and September up to the first severe frost, which kills the adults.

Means of Control. A simple means of control is suggested by the fact that the nymphs cannot thrive on the foliage of trees, but go to the ground and feed on plants such as thistles or other weeds; hence if the orchard is plowed and kept free of weeds during May and early June the nymphs will be starved. Trees that have already been weakened should be given good cultivation and fertilized to stimulate growth and enable them to recover more rapidly. Of course, care should be taken not to cultivate too long for fear of winter injury.

ROUND-HEADED APPLE-TREE BORER (*Saperda candida* Fab.).

This borer works in the trunks of apple trees usually near or a short distance below the surface of the ground. Here it feeds upon and makes tunnels in the inner bark and the wood. Trees of almost any age may be attacked, but far the most damage is done to young trees from three to ten years old. These not infrequently are completely girdled and killed. The insect is not found in all orchards but often localizes itself in an orchard here and there, while orchards not far away may be free from it. Apparently it is most numerous in the neighborhood of woods which contain such trees as hawthorn, juneberry, choke-cherry and mountain ash, all of which are host plants and so may serve as breeding quarters. In addition to these trees and the apple it attacks also quince and pears.



Round-headed Apple-tree Borer, adults and full-grown larvæ, natural size. (After Rumsey and Brooks.)

The adults are handsome, nearly cylindrical, stout beetles about an inch in length and having long antennæ. They may easily be identified by the white color of the under surface of the body, the brown color of the upper surface, and the two conspicuous white bands that extend along the back the whole length of the insect. The larvæ, which do the injury, are stout, nearly cylindrical, whitish grubs about an inch long when full grown, with a brown head, and the segments just below this a little larger than the remaining segments.

Life History. The beetles emerge from the trees in May and June and in a week or two begin laying their eggs in the bark near the base of the trunk. Egg-laying continues for about two months, after which the beetles die. The larvæ on hatching feed the first season chiefly on the inner bark, though some enter the sapwood. During the winter they remain dormant but next spring resume their feeding and work into the solid wood. Throughout the course of their feeding a considerable amount of the sawdust-like borings are thrown out through the bark. Some of the larvæ are full grown or practically full grown at the end of the second season, and next spring pupate and emerge as adults, but others are smaller and pass a third season as larvæ, pupating and emerging as adults the

next year. Where there have been several borers in a small or moderately small tree, there are naturally many burrows in the wood. The writer has seen mountain ash trees so infested that a person by pushing hard could break off at the base a tree of four inches in diameter.

Methods of Control. Unfortunately, there is no method of control that is at the same time easy, rapid and effective. The one most commonly used is to remove the borers from the trees with a sharp knife and a fine wire with a little hook on the end. The wire is worked into the holes where the borers cannot be easily reached with the knife. If a bottle of carbon bi-sulphide and some cotton batting are carried along, a small wad of the batting may be saturated with this liquid and forced into a hole to kill any borer that cannot easily be destroyed otherwise. The hole should at once be stopped up with moist earth to keep the fumes in. When cutting, do not injure the trees unnecessarily. The cutting out of the borers should be done in May and October each year so as to destroy as many larvae as possible while they are still small, easily reached (just under the bark) and have not done much damage. The earth should always be removed for a few inches around the base of the trunk and each tree examined even though no saw-dust may be visible on the bark or ground.

It is claimed that pure white lead and linseed oil of a little thicker consistency than ordinary paint can be safely applied to the trunks in May or early June and will prevent egg laying. The lead should thoroughly cover the trunk from about two inches below the ground to one foot above it and must be renewed yearly. Newspapers or building paper wrapped around the trunk and securely tied at the top so the beetles cannot get in to lay eggs is also said to give good results. It should be put on towards the end of May and the earth heaped up a few inches around the bottom so the beetles will not get in below it. These wrappings should be removed in early September.

Clean cultivation by keeping the weeds down during the earlier part of the summer seems to help in keeping orchards free, for the beetles seem to prefer neglected orchards and shady surroundings.

OTHER INSECTS ATTACKING THE APPLE.

Plum Curculio.
Red Spiders.

Fruit-tree Bark-beetle.

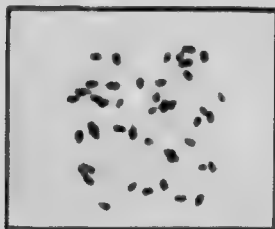
INSECTS ATTACKING THE PEAR.

PEAR PSYLLA (*Psylla pyricola* Forester.)

The Pear Psylla, though not so destructive in Ontario as in some other parts of North America, is a very troublesome pest and a source of much worry to pear growers. Fortunately, it is not abundant every year, as some years it almost disappears, at least during all the earlier part of the season, but the next year it may again be almost as numerous as ever. These fluctuations seem to be largely determined by weather conditions, especially spring conditions. Cold, backward weather after the buds have begun to burst seems to be the chief factor in lessening its numbers by destroying the eggs and newly hatched nymphs.

The adult Psyllas are, as shown in the photograph, very tiny insects, not more than one-tenth of an inch long. Seen through a hand lens they resemble a diminutive cicada. To the unaided eye the color of their bodies appears black or brownish, but closer observations show that the ground color is reddish.

The nymphs are very different in appearance and color from the adults, being pale yellowish or whitish, with red eyes. The body, too, is broader and flatter in proportion to its length than that of the adult. Nymphs are usually most easily found on the leaves in a drop of honey-dew.



A group of Pear Psylla adults, natural size. (Original.)



Pear-tree Psylla, greatly enlarged. (After Marlatt.)

The injury is done by both the adults and nymphs, and is caused by their sucking the juices out of the leaves, leaf-stems and fruit-stems, thus weakening the trees and dwarfing the fruit. As the insects feed they send out great quantities of honey-dew, which falls everywhere on the leaves, fruit and branches, and makes these not only sticky but also black and unsightly. The black or sooty appearance is due to a fungus which grows in the honey-dew. In addition to this dirty, sooty appearance the foliage on badly infested trees has a sickly yellowish color which indicates clearly the drain the insects make on the vigor of the tree. Pears seem to be the only plants attacked.

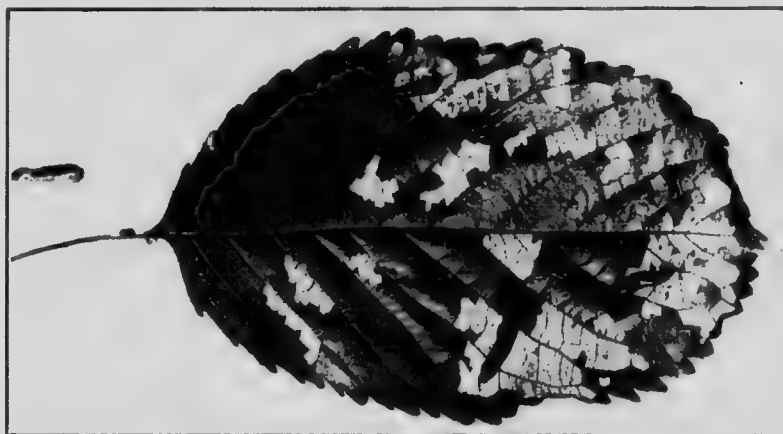
Life History. The winter is passed in the adult stage. The adults are hidden in crevices on the trees or under loose bark or under other shelter, usually on or near the infested trees. In spring, when the bright sunny days towards the end of March or in early April arrive, the adults come forth from their hiding places and after a short time commence egg-laying. These eggs are just visible to the naked eye. They are yellowish or pale orange in color, more than twice as long as broad, and are placed chiefly on the twigs and fruit spurs, usually in some little crevice. If the weather is mild the eggs begin hatching about the time the buds have begun to burst, and continue to do so for some time longer. The nymphs feed as mentioned on the leaves and the stems of the leaves and fruits, and become adults in about four weeks. The new generation of adults lay their eggs chiefly on leaf-stems and on leaves, in the latter case usually along the midrib or the margin of the leaf itself. There are at least three and probably four generations a year in Ontario. Adults of the last generation continue feeding until the severe cold weather in late fall drives them into winter quarters.

Methods of Control. Postpone the so-called dormant spray with lime-sulphur, using in this case a strength of 1.030 sp. gr. (1 gal. commercial lime-sulphur diluted with 8 or 9 gals. of water) until the leaf buds have just opened, and then spray the trees thoroughly. This kills recently hatched nymphs and eggs that are near hatching. Some of the more tender varieties of pears may be a little

injured by this application, but as a rule not much injury is done. As a supplement to this spray, add nicotine sulphate 40%, or Black Leaf 40 to the Codling Moth spray. (See Spray Calendar.) Directions as to the proper amount of these tobacco extracts are given on the cans. This application should be done very thoroughly and in such cases will sometimes, even without the delayed dormant spray, give satisfactory control. It is wise, however, in all orchards that suffer much from this insect to give both treatments.

PEAR (AND CHERRY) SLUG (*Eriocarpoides linacina* Retzius.)

The Pear Slug is even more common on sweet and sour cherries than on pears. It is a slimy, blackish or greenish-black larva, a little more than half an inch long when full grown and distinctly enlarged toward the head end, having thus the appearance of a tiny tadpole. The larva is found on the upper side of the leaves of cherries, pears and occasionally plums, where it devours the green tissues, leaving an unbroken network of large and small veins, which, of course, soon turns brown. Some years the insects are very abundant, and acres of sweet or sour cherries may be so injured that the foliage appears as if it had been smitten by some blight and killed. Trees severely attacked for two successive years are much injured and sometimes many of the branches die. These years of great abundance are not very common and some seasons the slugs are so scarce that they do almost no damage.



Pear Slugs and their work on Cherry leaves, natural size. (Original.)

Life History. The winter is passed in the full grown larval stage in a small earthen case in the ground a short distance below the surface. In the spring it pupates and soon after the blossoms have dropped from the pears the adults emerge. These are little black sawflies, about a quarter of an inch long. They lay their eggs in the tissues of the leaves and about the middle of June the tiny slugs may first be seen feeding on the upper surface. Early in July these become full grown, and then drop to the ground, where they soon pupate in the soil. In about three weeks new adults begin to appear from these and continue to emerge for several weeks. Larvæ or slugs from this brood may be found late on into autumn. When full grown they all drop to the ground, work their way

below the surface, form little earthen cases about themselves and remain there over winter.

Methods of Control. This is an easy insect to control. Arsenate of lead at the strength of 2 or 2½ lbs. (paste) to 40 gallons of water applied to the foliage as soon as there are seen to be sufficient of the slugs present to justify spraying, will destroy them. Sometimes a second application may be necessary for the second brood of larvæ. The chief difficulty is that the injury is usually done, especially on small trees, before the owners notice the presence of the insects. This is, however, merely due to failure to look for them and not to any difficulty in determining their presence. If only a few trees are affected, dusting them several times with fine dust or air-slaked lime will kill the larvæ.

THE PEAR-LEAF BLISTER-MITE (*Eriophyes pyri* Pagenstecher.)

This mite is a tiny, white or pinkish, nearly cylindrical creature, about five times as long as wide and so small that it is scarcely visible without the aid of a hand lens. It is not a true insect and has only two pairs of legs in the adult stage, whereas insects have three pairs.



Blister Mite work on apple and pear leaves. (Original.)

The pest is widely distributed throughout the province, and attacks apples as well as pears. The injury is done almost entirely to the foliage. On this the mites cause numerous little blisters on the under surface. Sometimes these are so abundant that there may be more than one hundred to a single leaf. As the immediate portion of the leaf where the blister is formed soon dies, this means that on badly infested trees a large part of each leaf may be killed. Many of these leaves turn yellow early in the season and drop, and the remainder through the loss of some of their green matter (*chlorophyll*), are unable to perform fully

their proper function of manufacturing food for the fruit and other parts; consequently the whole tree is weakened. The mites often attack the fruit and fruit stems while these are still very small and cause little blisters on them, but later these blisters all disappear without leaving any visible injurious effects. On the leaves blisters are at first light colored, sometimes yellowish-white, but later on the pear they turn first nearly red and then nearly black, and on the apple reddish-brown.

Life History. The winter is passed by the mites under the protection of the bud scales. In spring, soon after the buds have burst and the leaflets have begun to expand, they move about and soon work their way through the epidermis of the under surface and feed in the interior of the leaf, gradually causing a blister to appear. Inside these blisters or burrows they lay their eggs and produce their offspring. The young mites when full grown work their way out through a little hole in the blister and soon make new blisters on the same or on other leaves. There are several generations in a season. Towards the end of October the mites desert all the leaves and go into winter quarters in the buds.

Methods of Control. This is one of the easiest of all our pests to control. The best method is to spray the orchard thoroughly with lime-sulphur, strength about 1.030 sp. gr. (1 gal. commercial lime-sulphur to 9 gal. of water) any time in the spring from the time the ground is fit to drive on until the buds are actually bursting. It is claimed by some that fall spraying after the leaves have fallen is equally effective, but the writer has not been able to test it. One thorough application in spring covering every bud will practically annihilate the pest.

OTHER PEAR INSECTS.

Codling Moth.
Green Fruit-worms.
Bud-moth.
Cigar-case-Bearer.
Fruit-tree Leaf-Roller.
White-marked Tussock-moth.

Fall Web-worm.
Apple Tent-caterpillar.
Forest Tent-caterpillar.
Pear Scale.
Pear Tree Scale.
Pear Tree Bark-beetle.

INSECTS ATTACKING THE PLUM.

PLUM CURCULIO (*Conotrachelus nenuphar* Herbst.)

The Plum Curculio is a small, hard-shelled, rough-backed, greyish-black beetle about 1-5 of an inch long, and with a conspicuous snout, at the end of which are little, inconspicuous, biting mouth parts. The larva is a stout, curved, whitish grub about 2-5 of an inch long, with a brown head and no legs. Both the adults and larvæ injure the fruit. The insect occurs in all the fruit growing parts of the Province. It does not, as the name would suggest, confine itself to the plum, but attacks the fruit of all our orchard trees and also of wild plums, haws and occasionally gooseberries. It usually does most damage to apricots, plums and sweet cherries, but apples, pears and peaches are also often much injured. Orchards situated near woods or thickets or where long grass, weeds, brush and other rubbish abound are worst attacked, because such places afford ideal winter quarters for the beetles. For the same reason rubbish, weeds and long grass inside the borders

of the orchard itself will lead to an increased infestation. There are several kinds of injuries done to the fruit. First, many apples and pears and some peaches become deformed as a result of early feeding punctures and egg-laying injuries. Second, nearly all apples, pears, plums and most of the peaches in which the larvæ occur drop prematurely. Cherries are an exception, as they remain on the



a, a, a, Small lumps of earth showing the pupæ in their little oval chambers; *b*, a dark circular area in the lump showing the empty chamber after the pupa has been removed; *c*, an adult beetle after transforming and still in the pupal chamber; *d, d, d, d*, adult beetles, all natural size. (Original.)

trees and usually rot. Third, the adults in late summer and autumn eat holes through the skin of apples and peaches and feed on the pulp beneath, thus making cull fruit. Fourth, disease, especially Brown Rot, gets into peaches and sometimes other fruits through the wounds made by these beetles. In these various ways orchards in situations specially favorable for the Plum Curculio often suffer very



Apple showing the crescent-shaped cuts made by the females after laying eggs, natural size. (Original.)



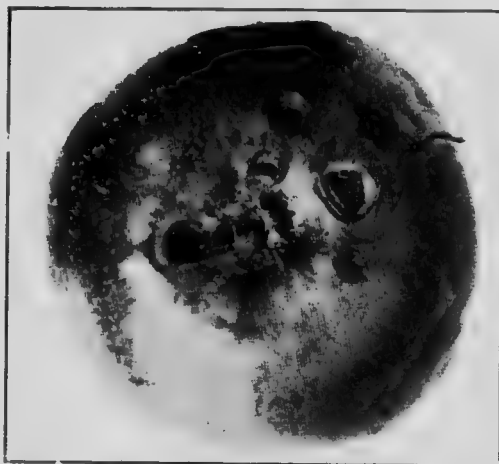
Full-grown larvæ and their work in a fallen apple, natural size. (Original.)

heavily. Sometimes plum and cherry trees have almost every fruit destroyed. Apples and pears are seldom so badly affected as this, though the loss in their case is sometimes severe.

Life History. The Curculios winter in the beetle stage in any good hiding place such as long grass or rubbish in or near the orchard. In Ontario they usually seem to come out of their winter quarters about the time the apples are in bloom.

Egg-laying begins almost as soon as the various kinds of fruit are set and continues actively for a month, after which it quickly slackens off. The eggs hatch in about five days and the larvæ work their way into the fruit and feed upon the pulp. The infested fruit, as we have said above, with the exception of cherries, nearly always drops soon and the larvæ finish their development in it on the ground. They are full grown in about two weeks, then enter the soil from about one-half to two inches and pupate in little oval earthen cases or chambers, which are easily broken. In about a month the new generation of beetles begins to emerge, and after feeding for some time on the fruit and foliage seeks good hiding places and hibernates.

Methods of Control. The first step in control is to secure as clean conditions as possible in and around the orchard by removing all sorts of rubbish and sheltering places in which the adults may hide for winter. It is wise, whenever practicable, to cut down and burn all shrubs or thickets nearby. The next step is to cultivate the orchard well as long as one may without fear of winter injury. Cultivation destroys the pupæ in the soil and also helps in other ways. The last step is to spray with a poison. Spraying is very important but no more so than



Fall or late summer injuries on apple made by the feeding of the new generation of beetles. These injuries, though natural size, are larger than the average. (Original.)



Fall or late summer injuries made on peach by the feeding of the new generation of beetles, natural size. (Original.)

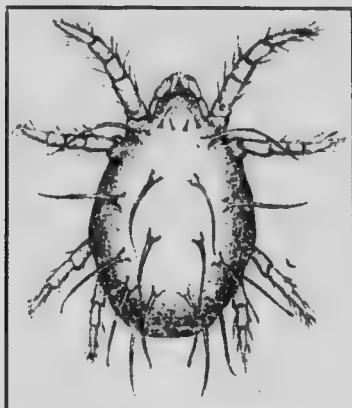
the cultivation and destruction of rubbish. The first spraying for apples and pears should be with the same mixture and at the same time as the Codling Moth spray. (See page 7). If the insects are very abundant a second application should be given about two weeks later. In this the lime-sulphur may be omitted if the weather is warm and dry and thus unfavorable for the development of Apple Scab.

Plums and cherries should be sprayed just as soon as the fruit has set and the calyces have dropped. The mixture should be about 3 lbs. of arsenate of lead added either to 40 gals. of lime-sulphur diluted to 1,000 sp. gr. (1 gal. commercial lime-sulphur to 35 gals. of water) or to 40 gals. of Bordeaux mixture (4.4.40 formula). A second application of the same mixture should be given in two

weeks or a little less. Peaches often do not require any spraying for this insect, but in a situation favorable to the insect they should be sprayed once with 2 to 3 lbs. arsenate of lead in 40 gallons of water as soon as the fruit is all well set. No lime-sulphur or Bordeaux mixture should be used with the poison.

RED SPIDERS.

Red Spiders are very small, eight-legged, oval-bodied creatures, not so large as the head of a pin. In Ontario there are two common species that attack fruit trees, one of these, *Tetranychus bimaculatus* Harvey, is a common pest on greenhouse plants, sweet peas, phlox and many other plants, but fortunately does very little damage to fruit trees; the other species, whose presence in Ontario was not discovered until 1912, is of much more importance in the orchard, because it occurs



Red Spider (*Tetranychus pilosus* or possibly *mytilaspidis*), much enlarged. (Original drawing by Miss M. Hearle.)

in all our fruit districts and often attacks in great numbers the leaves of European plums. It is found also on apple, cherry and pear foliage, but usually to a much less extent, though it sometimes does considerable damage to apples.

There is some doubt as to the name of this species. Mr. Nathan Banks thinks it is probably a European species, *Tetranychus pilosus*, but says that apart from its feeding habits it would appear to be identical with the Citrus Mite, *Tetranychus mytilaspidis* Riley. In any case, it is easily distinguished from the common Red Spider mentioned above in the following ways: (1) It is always, even in the youngest stages, red, whereas the other species may be a very pale yellowish-white, or green or red. (2) Under a hand lens it is seen to have little whitish tubercles on the back from each of which a fine hair arises. These tubercles are lacking in the other species. (3) It feeds on both surfaces without any web, whereas the other species feeds almost entirely on the under-surface and under the protection of a very fine web. (4) Its eggs are red and are laid on both surfaces, whereas the eggs of the other species are colorless like a little drop of dew, and are laid in or beneath the web. (5) It winters in the egg stage, the winter eggs being red, and situated on the branches of trees, especially at the forks of branches; the other species winters as adults in the ground or under good shelter.

The injury done by this newly discovered species is brought about by numerous individuals feeding on both surfaces of the leaves and sucking the juice out of them. Badly infested European plum foliage becomes covered with countless little whitish blotches, and after a time looks at a distance as if it had been dusted over with fine road dust. The injury to the foliage weakens the trees and results in small fruit of poor quality.

Life History. The winter, as stated, is passed in the egg stage on the bark, there often being thousands of eggs on a few square inches of surface. They hatch in spring soon after the buds burst and the young begin to feed on the developing leaves. When full grown they lay their eggs on the leaves. There are several, probably many generations a year. In September and October eggs for winter are laid on the bark and the adults are later killed by the cold.

Methods of Control. Experiment on a small scale lead us to believe that lime-sulphur, though it will not kill the eggs, will kill the mites themselves; hence trees, especially plum trees, that are badly infested, if sprayed with this mixture instead of Bordeaux at the times and at the strength indicated in the Spray Calendar, are not likely to suffer much. The liquid should be applied to both surfaces of the leaves.

OTHER PLUM INSECTS.

Green Fruit-worms.
Bud-moth.
Cigar-case-bearer.
Fruit-tree Leaf-roller.
Canker-worm.
White-marked Tussock-moth.

Apple Tent-caterpillar.
Forest Tent-caterpillar.
Buffalo Tree-hopper.
San José Scale.
Oyster-shell Scale.

INSECTS ATTACKING THE CHERRY.

CHERRY FRUIT-FLIES (*Rhagoletis cingulata*, Loew and *R. fausta* Osten Sacken.)

Cherry Fruit-flies are two-winged flies a little smaller than the House-fly and closely related to the Apple Maggot. They are the insects which cause the little white maggots often found in ripe cherries or sometimes at the bottom of baskets of this fruit. Infested fruits may appear to be sound but on opening them the



A female White-banded Cherry Fruit-fly, much enlarged. (Original.)

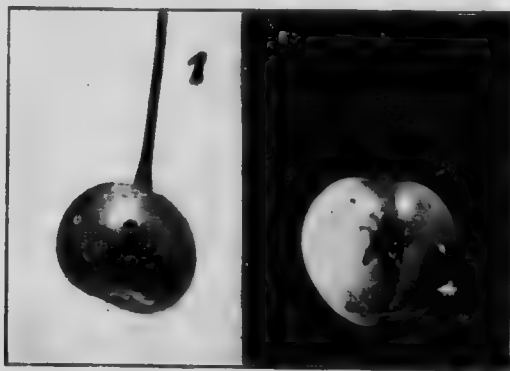


A female Black-bodied Cherry Fruit-fly, much enlarged. (Original.)

maggots can be seen clearly and also the filthy brown mass that results from their feeding.

There are two species of these flies, which we have named from their respective appearance, the White-banded Cherry Fruit-fly (*Rhagoletis cingulata*) and

the Black-bodied Cherry Fruit-fly (*Rhagoletis fausta*). The former species is a little smaller and is characterized by the distinct white crossbands on the abdomen of the male and four on that of the female, and also by the arrangement of the dark markings on the wings, as illustrated. The latter species has its abdomen entirely black without any white crossbands, and has the markings on the wings arranged as in illustration. The larvæ of both species are so nearly alike that



Cherry Fruit-flies on the fruit: (1) the Black-bodied Cherry Fruit-fly; (2) the White-banded Cherry Fruit-fly.

they cannot be distinguished except by a trained entomologist. They are when full grown about one-quarter of an inch long, nearly cylindrical, blunt at one end and tapering to a point at the other. Their color may be either white or yellowish. There is no head and no legs, but at the small end are two little black hooks used to tear the tissues of the fruit and set free the juice upon which the larva feeds.



Full-grown larvæ of Cherry Fruit-flies in the fruit, natural size. (Original.)

The White-banded species seems to be the more abundant in the Province and either it or the other species has been found in almost every country where cherries are grown on a commercial scale. They do not, however, infest all or nearly all the orchards in any county, but a sufficient number are infested to cause great loss. Early varieties as a rule are not much affected but late varieties such as Montmorencies, Morello and some of the late sweet kinds may have more than 90% of the fruit infested and therefore not be worth picking. Wormy fruit is

very subject to Brown Rot disease. The insects do not attack plums or other orchard fruits.

Life History. In June, when the Early Richmond cherries are just beginning to show the least sign of red, the adult flies of the Black-bodied species begin to appear, followed about a week later by the other species. Both species move about upon the leaves or fruit of cherries or other fruit trees for about ten days before they begin to lay eggs. During this time they may often be seen to have their broad, rasping lip-like mouths extended in search of juice or any little particles of food on leaves or fruit, just as a House-fly may be seen seeking its food. The eggs are laid in the fruit below the skin by the sharp, bee-sting-like ovipositor of the female. In five days or a little more they hatch and the tiny larva works its way at once to the pit, where it feeds on the juices of the pulp. It is not full grown until the fruit is ripe or even over-ripe. Then it works its way out, drops to the ground and burrows beneath the surface a short distance. Soon after this it changes its form until it resembles a small, plump grain of wheat (*puparium*). Inside this it pupates and remains in this stage over winter and until it emerges as an adult in spring.

Methods of Control. Extensive tests have shown that these insects can be thoroughly controlled by spraying the trees with 2 or 2½ pounds arsenate of lead (paste), with or without one-half gallon of cheap molasses to 40 gallons of water. The first application should be just as the fruit of the Early Richmond variety is beginning to show the first sign of red and the second application just as the Montmorency variety is beginning to show this red tint. The object of both sprayings is to kill the adults before they can lay their eggs. Therefore, promptness in applying the spray at the right time is very essential. At the first application the foliage of all kinds of cherries except very early sweet cherries should be sprayed. It will also pay to spray the foliage of any other kind of fruit tree nearby, as the flies often frequent them for a few days before ovipositing. At the second application only the late varieties should be treated as the early ones are too nearly ripe at this time. About one gallon of the material shot up into and upon the leaves is sufficient for a good sized tree, so that one barrel will suffice for forty or fifty trees. The cost per tree for the mixture need not exceed two cents. Neighbors should be encouraged to spray their orchards at the same time, because the insect moves about freely. Moreover, all wild sweet cherry or all useless cherry trees should be cut down that they may not serve as breeding grounds.

CHERRY APHIS (*Myzus cerasi* Fabricius.)

This is a glossy black aphid which attacks the leaves, especially of sweet, and more rarely of sour cherries. On the latter the leaves are seldom rolled, but on the former they are much rolled, curled, and distorted. Leaves on new shoots are usually worst affected. When badly infested they turn yellow, die, and later may drop off. Sometimes the aphids get on the fruit itself and cause it to become sticky and dirty. Badly infested trees are rendered very unsightly and are weakened.

Life History. The winter is passed in the egg stage. The eggs are glossy black and situated chiefly between the buds and the bark. They hatch in spring about the time the buds have become green and just begun to open at the tips. So far as known, these aphids have no alternate host plant or plants to which they migrate in summer.

Means of Control. It is seldom necessary to treat sour cherries, but sweet cherries should be sprayed heavily with lime-sulphur, strength 1.035 sp. gr. (1 gal. of commercial lime-sulphur diluted with $\frac{1}{2}$ gals. of water) and nicotine sulphate 40%, or Black Leaf 40, as soon as the eggs have hatched. This, as said above, is when the buds have just begun to burst, but the leaflets and blossoms have not actually opened. This spraying, of course, takes the place of the dormant spray. To give the best results care should be taken to cover every bud thoroughly. It is almost impossible to obtain good results after the leaves have curled. If, however, the early treatment which has just been recommended has been omitted, the next best time to spray is just after the fruit has set. Here the tobacco extract may be used with the regular second spray of lime-sulphur or Bordeaux mixture and arsenate of lead as given in the Spray Calendar. The proper strength of the tobacco extract is stated on the cans.

FRUIT-TREE BARK-BEETLE OR SHOT-HOLE BORER (*Eccoptogaster rugulosus* Ratzeburg.)

Sometimes in peach, cherry and plum orchards a tree here and there will be found with numerous small gum masses exuding from the bark of the trunk and branches. If the outer bark at these spots is removed with a sharp knife



Cherry Aphids on underside of sweet cherry leaf, natural size. (Original.)



Work of Fruit-tree Bark-beetles and their larvæ, natural size. (Original.)

and there is revealed a little eaten area through which the gum is exuding, it is evidence that the injury has been caused by one of the Fruit-tree Bark-beetles (*Ipidæ*) of which by far the most common species in Ontario is the one mentioned above. The adult is a tiny reddish-black beetle about one-tenth of an inch long. It usually infests only dead or dying branches, attacking healthy ones only where

these others are absent. Some years, however, the beetles seem to have a fondness for boring into the base of buds on healthy trees and killing the . . . We have frequently seen this occur on sweet cherry trees, and it is not uncommon also on pears. In the latter case if the beetles have previously been feeding on the dead bark over a blighted portion of a pear tree they may communicate this disease to healthy pears.

Though the beetles may feed on healthy trees and weaken them by the great amount of gum that exudes from numerous holes, yet they cannot lay their eggs in such trees, because the gum drives them out, hence they breed only in dead or dying trees.

All kinds of fruit trees, and also wild cherry and Juneberry trees are subject to attack.

Life History. The beetles appear in June and soon begin eating holes through the bark of dead or dying trees. Underneath this they construct a burrow about an inch long (illustration) and lay their eggs along each side of it. The larvæ from these eggs make little burrows more or less at right angles to the main burrow, and feed on the wood and bark as they do so. As they grow they increase the size of the burrows, and when full grown usually eat a little deeper into the wood and pupate there. Full grown larvæ are stout white little grubs without any legs. The new generation of beetles begins to appear about the middle of August and may be found in the orchards until late fall. These in turn eat through the bark, construct their egg burrows and produce a second brood of larvæ. All the adults die before winter, but the larvæ remain as such in their burrows under the bark until next May and June, when they pupate. Hence there are two full generations a year.

Methods of Control. The fact that the insects pass the winter only in the larval stage and only in dead or dying trees or branches, shows that the best method is to remove during late autumn or winter or early spring all dead or dying trees and branches, and burn them all before June to destroy the larvæ. It is not safe even to cut off the larger branches and trunks and pile them up as cordwood and leave them there. We have seen several severe attacks on healthy trees come from such piles. When healthy trees have been attacked these need not be cut down unless the trees are clearly so weakened as to be dying. They should instead be pruned and the ground well fertilized and cultivated. Where this is done they usually recover. Attacks on healthy trees can sometimes be warded off by promptly whitewashing the bark with thick whitewash made of freshly slaked lime and water. To every pailful of which about one-quarter lb. of salt has been added as a sticker.

OTHER CHERRY INSECTS.

Bud-moth.
Fruit-tree Leaf-roller.
Canker-worm.
Apple Tent-caterpillar.

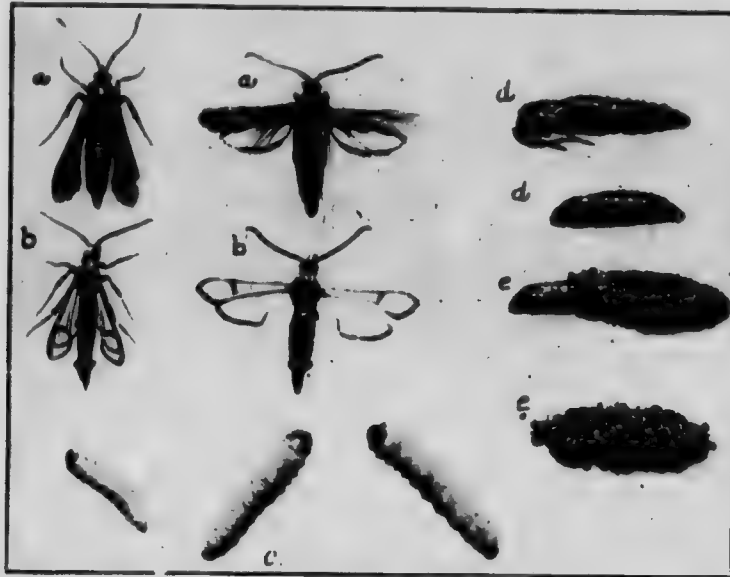
Buffalo Tree-hopper.
San José Scale.
Pear and Cherry Slug.
Plum Curculio.

INSECTS ATTACKING THE PEACH.

PEACH-TREE BORER (*Sanninoidea eritiosa* Say.)

This is the most common insect enemy of the peach in Ontario. It occurs in almost every orchard. In some it causes much damage, but in others very little. Plum, cherry and apricot trees are also occasionally attacked, but the insect much prefers the peach to these.

The injury is caused by the larvæ, which act as borers and feed on the inner bark and sapwood of the trunk, usually at or a little below the surface of the ground. Many larvæ may attack a single trunk at the same time; for instance,



The Peach-tree Borer: *a, a*, adult females; *b, b*, adult males; *c, c*, full-grown or nearly full-grown larvæ; *d, d*, pupæ, the upper one being empty; *e, e*, cocoons or pupa cases, the pupa protruding from the upper one; all natural size. (Original.)

we have taken twenty from a four-year-old tree. Badly infested trees are either killed by the girdling of the trunk or are much weakened and are therefore liable to perish during the winter. The presence of the borers is usually indicated by large gum masses which exude from the injured area, but often these masses cannot be seen without removing the earth from around the base of the tree.

Life History. The winter is passed in the larval stage either in the burrows in the wood or in little winter cases on the bark. Some of the larvæ at this stage are quite small, while others are nearly full grown. The larger ones are usually in the wood and the smaller ones in the little cases. A full grown larva is about one inch or a little more in length, moderately stout, cream to pale yellowish in color, with a brown head and with three pairs of true or jointed legs and five pairs of prolegs or false legs.

In the spring the larvæ resume their feeding, and when full grown pupate in silken cocoons covered with brown castings (illustration). These cocoons may easily be found in the soil close to the trunk. The adults that emerge from them

are pretty, clear-winged moths, resembling considerably some of our common wasps. They fly in the daytime. The female can readily be distinguished from the male by the presence of a broad orange band around the abdomen. Moths, judging from our observations in the year 1915 in Norfolk County, may begin to emerge as early as July 1st, and may continue to do so until the first week in September. The writer saw an adult female in the Niagara district on September 11th, 1915. Egg laying begins soon after emergence. As many as 800 eggs may be laid by a single individual. These are deposited chiefly on the trunk of the trees, but we found many also on both surfaces of the leaves. The young larvæ on hatching work their way to the ground and there feed for a time on the bark, gradually as they become older eating into the sapwood. When cold weather arrives they become dormant and remain so until the next spring. There is only one generation a year. Possibly a few individuals spend two winters in the larval stage.

Methods of Control. Many control methods have been recommended, including several washes, but it is very doubtful whether any is so safe and effective as the old one of cutting out the borers with a knife, aided sometimes by a wire. This work should be done in late May or early in June before pupation begins and again in October. In doing it care should be taken not to injure the tree more than necessary and always to cut with, not against, the grain. The soil to the depth of a few inches around the base of the trunk must always be removed first with a trowel or other implement to get access to the larvæ below the ground. If earth is mounded up around the trunk to the depth of eight or ten inches in June, it prevents the larvæ working so low down and by removing it when cutting them out with the knife they can much more easily be found and destroyed. The mounds should be restored before winter.

Tree protectors have been tested, but in our experience are far from satisfactory.

LESSER PEACH-TREE BORER (*Sesia pictipes*, Grote & Robinson).

Both in the adult and larval stage this borer closely resembles the one just discussed. It is, however, in both stages a little smaller and the female has not the broad orange band around her abdomen, but resembles closely the male.



Lesser Peach Tree-borer,
adult female, about nat-
ural size. (Reduced from
King.)

There is considerable difference in the habits of the two species, for the Lesser Peach-tree Borer does not, like the other species, confine itself to any one part of the tree, but attacks indiscriminately the trunk, crotch and branches. Moreover, it does not enter the tree through the healthy bark, but always through some wound. The more wounds there are, the more abundant the borers usually are.

Consequently, orchards severely infected with cankers usually have many borers. This has led some growers to think that the borers are largely responsible for the cankers; but such is not the case. The most that can be said is that by working between the healthy and diseased tissues around the edges of cankered or wounded areas, they interfere with nature's healing process and gradually enlarge the dead area at the point where they feed. So far as our observations go, it is seldom that they actually cause the death of a tree or even of a branch; for, though many cankered branches die, their death can usually be shown to have been due chiefly to other causes than the borer.

In addition to the peach, the insect also attacks to some extent plum and cherry trees.

Life History. The chief differences between the life history of this and the preceding species is that the adults of this one begin to emerge about a month earlier (about June 1st) than those of the other species, and do not continue to emerge for so long a time, and that pupation takes place in the canker or wound near where the larvæ has fed. The winter is, of course, passed in the larval stage.

Methods of Control. From what has been said it is clear the best method of control would apparently be to keep the bark of the trees free from injury of any kind, but this cannot always be done. In cases where there are many cankers much can be gained, if, when pruning, all cankered branches that can be spared are cut off and burned. The remaining cankers should be examined in spring before the middle of May and as many of them as time permits cleaned out with a drawknife and stout sharp knife, care being taken of course to search for and kill the larvæ. Wounds may be painted with white lead. This cutting and painting process is also the chief way to stop a canker from spreading, even where there are no borers.

OTHER PEACH INSECTS.

Green Fruit-Worms.
Bud-moth.
Apple-tree Tent-Caterpillar.
Forest Tent-Caterpillar.

San José Scale.
Plum Curculio.
Fruit-tree Bark-Beetle.

SPRAY CALENDAR

PLANT AND PESTS.	1ST APPLICATION.	2ND APPLICATION.	3RD APPLICATION.	REMARKS.
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APPLE.

Scab or black spot, canker, leaf spot, codling moth and other biting insects, scale insects, blister mite and aphids. (Consult bulletins 187, 194, 198 and 219).

Either before or soon after the leaf-buds burst, preferably the latter. Use A1 or B. For San José Scale prune severely, scrape off loose bark and drench the whole tree, paying special attention to outer twigs.

Just before the blossoms open. Use A2 or D, with 2 or 3 lbs. arsenate of lead to each 40 gals. of the liquid.

Immediately after the blossoms have all, or nearly all, fallen, and before the calyxes close. Use A3 or D, with 2 lbs. arsenate of lead to each 40 gals. This is the application for codling moth.

For Scab, a 4th application about 10 days after the 3rd is necessary if June is wet, also an intermediate one between the 2nd and 3rd with A3, *without any poison*, if the interval, owing to cool damp weather, threatens to be long. Spraying with the weaker A3 early in August is an insurance against sooty fungus and late scab. If Aphids are annually troublesome, delay 1st application till buds begin to burst, then add Black Leaf 40 or nicotine-sulphate 40 per cent. to A1 or B and cover every bud. For Cankers cut out diseased bark, disinfect and cover with white-lead paint free from turpentine. For Blight on young trees keep suckers rubbed off trunk and main branches and cut out promptly any diseased branches or twigs well below the diseased bark. Always disinfect both cuts and tools with corrosive sublimate (1 to 1,000).



Stages for 1st application.

Stage for 2nd application.

Stage for 3rd application.

Scab or cracking, blight, codling moth, other biting insects, scale insects, blister mite, psylla and slug. (Consult bulletins 176, 187 and 219.)

shortly before or just after the blossoms fall. Use A3 after the bud bursts. Use A1 or B. For San José Scale see above under Apple. Use A3 have fallen. Use A3 or D, with 2 lbs. arsenate of lead to 40 gals. of liquid. Use A3 with 2 lbs. arsenate of lead to 40 gals.

PLUM AND CHERRY:

Black knot, brown rot, leaf blight or shot-hole fungus, curculio, slug, aphids and cherry fruit - flies
(Consult bulletins 219, 226, 227 and 230.)

soon after the fruit is set. Use A2 or D, with 3 lbs. arsenate of lead to 40 gals. Use A3 or D, with 3 lbs. arsenate of lead to 40 gals. Use A3 or D, with 3 lbs. arsenate of lead to 40 gals.

For Cherry Fruit-flies (the cause of the little white headless maggots in cherries) use 3 lbs. arsenate of lead to 40 gals. of water. Apply to all cherry trees just as Early Richmonds are getting a reddish bluish, and again to only Montmorency and late varieties about 10 or 12 days later. Cut out and burn all Black Knots in winter and whenever seen in summer. For Slugs see under Pear above. For Aphids on Sweet Cherries postpone the 1st application until the buds are just bursting, and then add nicotine-sulphate 40 per cent. or Black Leaf 40. Good pruning with plenty of sunlight and air help against Rot.

PEACH.

PEACH. Before the buds begin to swell. (All must be done before any sign of bursting of buds.) Use A or B. This is usually the only spraying peach trees receive.

Soon after fruit is about one month after fruit is set. Use $\frac{2}{3}$ or 3 lbs. arsenate of lead. If troubled by Brown Rot use C or 1 or 2 lbs. freshly slaked lime dust with sulphur. Good pruning and thinning the fruit help to control this disease.

Note.—A1=Concentrated lime-sulphur strength 1:030 specific gravity (1:035 for San José scale) (1:030=1 gal. commercial to 9 gals. water, and 1:035=1 gal. commercial to 7 gals. water).

A2—Concentrated lime-sulphur strength 1:10 or 1:100 specific gravity=1 gal. Commercial to from 30 to 35 gals. water.

1.009 or 1.008 specific gravity=1 gal. Commercial to from 33 to 40 gals. water.

R = The old home-boiled lime sulphur. 20.15.40 formula. **C** = Self-boiled lime-sulphur. **D** = Bordeaux mixture, 4.4.40 formula.

FORMULAE FOR INSECTICIDES

INSECTICIDES FOR BITING AND LAPPING INSECTS.

1. ARSENATE OF LEAD PASTE.

Use 2 to 3 lbs. to 40 gals. of water, or of lime-sulphur or of Bordeaux mixture.

2. ARSENATE OF LEAD POWDER.

Use 1 to 1½ lbs. to 40 gals. of water, or of lime-sulphur or of Bordeaux mixture.

3. ARSENATE OF LIME (Calcium arsenate).

Use ¼ to 1 lb. if in powder form to 40 gals. of Bordeaux mixture. Double the amount if in paste form. (There is some doubt yet whether this poison is always safe with lime-sulphur. It is not safe alone).

4. PARIS GREEN.

Use ¼ to ½ lb. with 40 gals. of Bordeaux mixture. (This poison is not safe with lime-sulphur.)

FORMULAE FOR FUNGICIDES

I.—BORDEAUX MIXTURE.

Copper Sulphate (Bluestone) 4 lbs.
Unslaked Lime 4 lbs.
Water 40 gals.

Dissolve the copper sulphate in a wooden or brass vessel with hot water, pour into a barrel and add cold water to make 20 gals.; slake the lime, preferably with hot water; add cold water to make 20 gals. Stir both barrels well and pour lime into the copper sulphate barrel. (Never mix concentrated milk of lime and copper sulphate solutions).

A stock solution of each may be made kept indefinitely if not mixed:—Dissolve 40 lbs. copper sulphate in 40 gals. of water by suspending just below the surface of water in a coarse sack. Each gallon of liquid will now contain 1 lb. copper sulphate. Slake any desired quantity of lime and put into a box or barrel in shaded place, or sunk in the ground. Keep covered with small amount of water to exclude the air. Calculate how much is required for 4 lbs. lime if well stirred.

To test Bordeaux mixture, let a drop of ferro-cyanide of potassium solution fall into a little of the mixture in a saucer. If this causes it to turn reddish brown, add more lime until no change takes place.

II.—LIME-SULPHUR WASH.

1. HOME BOILED (for use on dormant wood only):

Fresh stone lime 20 lbs.
Sulphur (flour or flowers) . . 15 lbs.
Water 40 gals.

Slake 20 lbs. of lime in about 15 gals. or more of boiling water in a kettle or other boiling outfit. While slaking add the 15 lbs. sulphur made into paste by the addi-

240 divided by 30=8. This means that each gallon of such a wash must be diluted to 8 gals. with water to give us a strength of 1:030, the proper spring strength. For the second application 1:009 is about the right strength. To get it divide the 240 by 9, which gives 26½, or roughly speaking 27. This means that each gallon of a wash of the strength of 1:240 must be diluted to 26½ or 27 gals. to make the right strength for the second application. For the third application and any later ones 1:008 is about the right strength, and to get this we proceed in the same way and divide 240 by 8=30, so that each gallon must be diluted to 30 with water for this application. If the strength of the concentrated were 1:212 or any other number, you would in the same way divide the three figures to the right by 30, 9 and 8 respectively to get the proper dilutions for each spraying.

TABLE FOR CHANGING BEAUME READINGS INTO THEIR EQUIVALENT SPECIFIC GRAVITY READINGS.

Beaume.	Specific Gravity.	Beaume.	Specific Gravity.
18	= 1:141	27	= 1:230
19	= 1:150	28	= 1:240
20	= 1:159	29	= 1:250
21	= 1:168	30	= 1:260
22	= 1:178	31	= 1:271
23	= 1:188	32	= 1:282
24	= 1:198	33	= 1:293
25	= 1:208	34	= 1:305
26	= 1:219	35	= 1:317

Note.—Commercial lime-sulphur should be tested with the hydrometer and diluted according to the same rules as the home-made concentrated form.

INSECTICIDES FOR SUCKING INSECTS ONLY.

1. LIME-SULPHUR.

For scale insects, Blister Mites and Red Spider.

2. TOBACCO EXTRACTS.

For Aphids, Leaf-Hoppers, Psyllas, etc.

(a) BLACK-LEAF 40, strength to use is indicated on the cans.

(b) NICOTINE-SULPHATE 40%. Strength is indicated on the cans. (Practically same as Black Leaf 40).

(c) HOME-MADE EXTRACT. Soak 1 lb. tobacco refuse in 1 gal. water for 24 hrs. with occasional stirring, or steep 1 lb. in 1 gal. water for 1 hr. Make up for water that evaporates. Use at once without dilution: spoils in a few days if not used.

3. KEROSENE EMULSION.

Kerosene (Coal Oil) 2 gals.
Rain Water 1 gal.
Soap 1/2 lb.

Dissolve the soap in water by alicing and boiling; take from fire, and while hot pour in kerosene and churn vigorously for five minutes. For use dilute with 9 parts of water, so that the above 3 gals. of stock emulsion will make 30 gals. of spray mixture.

4. WHALE OIL SOAP.

For brown or black aphids, 1 lb. in 4 gals. rain water. For green aphids, thrip and leaf-hopper, 1 lb. in 6 gals. rain water.

tion of a little water. Boil vigorously, with stirring, for 1 hour. Dilute to 40 gals. with cold or hot water. Strain and apply at once.

2. COMMERCIAL LIME-SULPHUR. (Factory-made concentrated lime-sulphur).

This as purchased is usually about 1.290 specific gravity strength or 33° Baume.

3. HOME-MADE CONCENTRATED LIME-SULPHUR.

This may be used as a substitute for commercial lime-sulphur, but is only about % as strong as a rule.

Sulphur (a fine grade).....100 lbs.
Fresh stone lime, high in percentage of calcium... 50 lbs.

Water 40 or 50 gals.
Put about 10 gals. water in the boiling outfit, start fire, add sulphur, stir to make paste and break lumps, then add remaining water, and when near boiling put in lime. Stir frequently while slaking and until all the sulphur and lime are dissolved. Add water from time to time to keep up to 40 or 50 gal. mark. Boil 1 hour, then strain through a screen of 20 meshes to inch into storage barrels. Make enough at once for season's work. Cover well to keep out air, or pour oil of any kind over surface to depth of 1/4 inch for same purpose.

To determine how much to dilute for different applications use a hydrometer with specific gravity readings, and apply the following rule:

Put the hydrometer in the clear liquid when it is cold and the sediment has all been settled for a day or two. Note the number to which it sinks. Suppose this is 1:240. The strength for use before the buds burst should be 1:030 or stronger. To determine how much to dilute a strength of 1:240 to get 1:030, divide the three figures to the right in 1:240 by 30, that is

4. SELF-BOILED (chiefly for use on peach foliage).

Fresh stone lime 8 lbs.
Sulphur (flour or flowers) .. 8 lbs.

Water 40 gals.

Best prepared in quantities of 24 lbs. at a time to get sufficient heat. Place 24 lbs. lime in a half barrel, add enough cold water to start it slaking well and to keep the sulphur off the bottom. Dust the 24 lbs. sulphur over the lime, having first worked the sulphur through a screen to break lumps, then add whatever further amount of water is necessary to complete the slaking. Stir well with a hoe to prevent the lime caking on the bottom. As soon as the slaking is over, add enough cold water to cool the whole mass and prevent further combination. Strain into spray tank. Keep well agitated while spraying.

5. DUST.

For biting insects and fungus diseases the substances used now are 85 to 90% of sulphur and 10 to 15 % of arsenate of lead powder. Dusting at this date (1917) is only in experimental stage.

III.—DISINFECTANTS (for pruning and for wounds on trees):—

1. CORROSIVE SUBLIMATE, 1 pint to 1,000 by weight (=1 tablet to 1 pint of water. Apply with a swab on end of a stick. *Caution.*—Corrosive sublimate is a deadly poison to man or beast if taken internally. It will also corrode iron or metal, so use in a glass or wooden vessel and be sure to wash these out very thoroughly when through using them.

2. LIME-SULPHUR about twice spring strength, or bluestone, 1 lb. dissolved in about 14 gals. water, may be used to disinfect wounds or cankers, but is not satisfactory in case of Pear Blight.

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